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TRANSMITTAL OF OPERABLE UNIT 2 PROJECT SPECIFIC PLAN (PSP) FOR PHASE I AN II OF THE OPERABLE UNIT 2 PRE-DESIGN FIELD INVESTIGATION

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Department of Energy
Fernald Environmental Management Project
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JAN 12 1995

DOE-0422-95

Mr. James A. Saric, Remedial Project Director
U.S. Environmental Protection Agency
Region V - 5HRE-8J
77 W. Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL OF OPERABLE UNIT 2 PROJECT SPECIFIC PLAN (PSP) FOR PHASE I AND II OF THE OPERABLE UNIT 2 PRE-DESIGN FIELD INVESTIGATION

The Department of Energy, Fernald Area Office (DOE-FN) is pleased to submit the enclosed Operable Unit 2 (OU2) comment response document along with the revised draft Project Specific Plan (PSP) for your review and approval. The report has been revised according to the comments received from United States Environmental Protection Agency (U.S. EPA) and the Ohio Environmental Protection Agency (OEPA), and is scheduled to meet the EPA submittal date of January 12, 1995.

The PSP response document contains complete responses and actions to the comments received. The changed PSP pages contain strikeout and redlined text with the associated comment response number to indicate changes to the November 6, 1994, document.

If you have any questions, please contact Rod Warner at (513) 648-3156.

Sincerely,

Johnny Reising
for Jack R. Craig
Fernald Remedial Action
Project Manager

FN:Jalovec

Enclosure: As Stated

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TECHNICAL REVIEW COMMENTS ON THE DRAFT PROJECT SPECIFIC PLAN FOR PHASES I AND II OF THE OPERABLE UNIT 2 PREDESIGN FIELD INVESTIGATION AT THE FERNALD ENVIRONMENTAL MANAGEMENT PROJECT (FEMP)

GENERAL COMMENTS

Commenting Organization: U.S. EPA Commentor: Saric
Section #: NA Page #: NA Line #: NA Code:
Original General Comment #: 1

Comment: The purpose of this draft project specific plan (PSP) is to define the most suitable location for the proposed disposal facility during Phases I and II of the planned investigation. More detailed geotechnical data will be collected at the selected location during Phase III for use in the design of the facility. In general, the proposed scope of the investigation would be adequate for the purpose of this PSP. However, it is not clear why samples from certain depths are selected for consolidation and compaction tests. (see specific comments # 11 and 16.)

Response: Agreed. Please refer to response/action for these specific comments.

Action: No action.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: NA Page #: NA Line #: NA Code:
Original General Comment #: 2

Comment: Many typographical errors exist throughout the draft PSP. Also, many references to attachments are incorrect. Considerable inconsistencies exist between the tables and the text found in Section 8.0. Most are included as specific comments. These errors hinder the readability and evaluation of this document.

Response: Agreed.

Action: The document was spell checked, and the inconsistencies corrected, between tables and text were completed, please refer to specific comments numbers 6, 9, 14, 15, 16, and 17. The reference to the attachments have been corrected on page 8-17, line 4, and page 8-38, line 29.

SPECIFIC COMMENT

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 1.0 Page #: 1-1 Line #: NA Code:
Original Specific Comment #: 1

Comment: It is unclear whether the predesign field investigation for the location of the on-site disposal facility is for disposal of waste materials generated from remediation at Operable Unit 2, as indicated in the title of this document, or for disposal of waste materials generated from site-wide remediation. The text should clearly state this purpose in the introduction section.

Response: The Disposal Facility is intended for waste materials generated from site-wide remediation.

Action: The following text was added to Page 1-1, line 4: "Also, the design will include accepting other waste material generated from site-wide remediation."

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 2.0 Page #: 2-1 Line #: 28 Code:
Original Specific Comment #: 2

Comment: The referenced for the glacial till report should be "(Parsons, 1994)" instead of "(DOE, 1994)."

Response: Agreed.

Action: The reference has been changed.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 4.3.1 Page #: 4-3 Line #: NA Code:
Original Specific Comment #: 3

Comment: In Figure 4-1, it is not clear if quality assurance (QA) activities are independent of investigation activities. QA activities should be conducted independently of the investigation activities. This independence should be shown in the figure and stated clearly in the text.

Response: QA is independent of the investigation activities as depicted on Figure 4-1, which shows QA does not fall under the Task Manager for the Pre-Design Investigation.

Action: Added the following text to Section 4.3.2, Page 4-4, Line 17.

- Quality Assurance - Independent of investigation activities and responsible for assuring field activities follow the identified procedures.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 5.1 Page #: 5-1 Line #: 29 Code:
Original Specific Comment #: 4

Comment: It appears that the site database of underground utilities will be checked only prior to drilling, trenching and soil boring and not prior to cone penetration tests (CPT). It is recommended that the presence of underground utilities be checked for all CPT locations.

Response: Agreed. Penetration permits are required for all activities which penetrate more than 2 feet vertically.

Action: "Cone penetrometer work" has been added to line 30.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.1 Page #: 8-1 Line #: 15 Code:
Original Specific Comment #: 5

Comment: This paragraph describes CPTs, but does not include their total number. Figure 8-1 shows 31 CPT locations. In addition, in Attachment 1, "Data Quality Objectives for Cone Penetrometer Tests for Disposal Cell Design, "Page 3 of 5, The Boundaries of the Decision the text states that "approximately 43 cone pentrometer samples are proposed"; and on Page 5 of 5, Obtaining Quality Data, the text indicates that 50 sampling locations should be used. This discrepancy should be resolved, and the correct number of CPT locations should be indicated in the text of Section 8.1.

Response: Agreed. The DQO number was very preliminary. However, Section 8 will be revised to reflect the correct number.

Action: The text on page 8-1, line 21, has been changed to in "Forty Nine CPT locations..."

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.2.1 Page #: 8-2 Line #: NA Code:
Original Specific Comment #: 6

Comment: Many of the numbers of samples to be controlled for testing that are listed in Table 8-1 do not match those listed elsewhere. For instance, Table 8-6 on Page 8-10 shows one remolded permeability test and two vertical permeability tests at Location 11468 for a total of three permeability tests. However, table 8-1 lists only two permeability tests. Except for locations 11468 and 11470, all other boring locations should list seven samples as shown in Table 8-6, not six samples as shown in Table 8-1. These inconsistencies should be corrected.

Response: Agreed.

Action: The Tables have been made consistent.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.2.1 Page #: 8-3 Line #: NA Code:
Original Specific Comment #: 7

Comment: In Table 8-1, the meaning for the symbol "X" is not clear. This symbol should be checked and removed, if appropriate.

Response: Agreed.

Action: X has been changed to 1.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.2.1 Page #: 8-3 Line #: NA Code:
Original Specific Comment #: 8

Comment: Because Table 8-1 is for soil samples only, the footnote on "s-soil samples" and "w-water samples" is inappropriate and should be removed.

Response: Agreed.

Action: The footnotes were deleted.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.2.2 Page #: 8-6 Line #: 21 Code:
Original Specific Comment #: 9

Comment: The text here specifies that hourly readings will be taken with a data logger at seven specified wells. However, only four of the seven specified wells are presented in Table 8-3. This discrepancy should be corrected.

Response: Agreed.

Action: Text on page 8-6, line 19 has been changed to coincide with Table 8-3.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.2.2 Page #: 8-6 Line #: 25 Code:
Original Specific Comment #: 10

Comment: The text in Section 8.2.2 and Table 8-3 do not agree. The text specifies seven wells that will undergo additional weekly water level measurement, but the bottom portion of Table 8-3 shows only six wells. Also, only wells 1444 and 11067 appear both here and in Table 8-3. These discrepancies should be reviewed carefully and corrections should be made as appropriate.

Response: Agreed.

Action: Text on page 8-6, line 24 has been changed to reflect locations on Table 8-3.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.2.3 Page #: 8-7 Line #: NA Code:
Original Specific Comment #: 11

Comment: Insufficient information is presented on the rationale for the selected sample depths and tests. Unless the base for the disposal facility is to be at about 15 feet below grade, some of the tests seem inappropriate. For example, most Proctor tests are performed on shallow soil samples because surface soil is more readily available for use as fill. In this case, surface soil is apparently not considered to be used as fill. The reason for using soils from 10 feet below ground surface for Proctor tests instead of surface soil samples should be fully explained.

Response: Presently, locating the cell is dependent on the gray clay which is at an average depth of approximately 11 feet. Therefore, soils at a 10 foot depth have a potential to be used as fill. Phase III geotechnical sampling will be used to obtain additional information for the design of the facility.

Action: A note has been added to Table 8-5 giving rationale for Proctor sampling.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.2.3 Page #: 8-7 Line #: 3 Code:
Original Specific Comment #: 12

Comment: The text states that there are 14 boring locations proposed for collecting soil samples to determine the solubility of uranium. However, Table 8-1 on Page 8-2 indicates that seven soil boring locations, not 14, will be used for determining toxicity characteristic leaching procedure (TCLP) total and isotopic uranium. The text should be revised for consistency.

Response: Agreed.

Action: The text on Page 8-7, line 6 has been changed to ...Seven of these locations are proposed to determine the solubility of uranium.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.2.3 Page #: 8-7 Line #: 26 Code:
Original Specific Comment #: 13

Comment: The text states that samples will be collected from seven borings to determine the partitioning coefficient, K_d. However, line 3 on this page states 14 soil borings will be collected. This discrepancy should be corrected.

Response: Agreed.

Action: Please refer to comment #12.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.2.3 Page #: 8-7 Line #: 14, 15, and 27 Code:
Original Specific Comment #: 14

Comment: The text refers to Table 8-4 for analytical methods, but there is no Table 8-4 in the document. Table 8-5, however, lists the analytical methods. Also sample depth information is presented in Table 8-6, not Table 8-5, as stated on line 14. The table numbers should be corrected so that the text agrees with the table numbers cited.

Response: Agreed.

Action: Tables have been changed to reflect the correct numbers.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.2.3.2 Page #: 8-7 Line #: 20 to 23 Code:
Original Specific Comment #: 15

Comment: The text states that soil samples will be collected from each boring, with one sample collected from the brown clay layer and one from the gray clay layer, for a total of 28 samples. The text further states that all samples will be analyzed for total uranium, isotopic uranium, TCLP total uranium, a TCLP isotopic uranium. However, Table 8-6 shows that a total of 27 samples will be analyzed for total uranium and isotopic uranium. This discrepancy should be corrected. In addition, total uranium and isotopic uranium analyses and TCLP total uranium and TCLP isotopic uranium analyses are to be conducted on samples taken at the same depths for the brown clay (5 feet) but at different depths (15 and 20 feet) for the gray clay. The text should explain why total uranium analyses and TCLP uranium analyses are to be conducted on soil samples taken from different depths of the gray clay.

Response: Agreed. TCLP analysis will not be conducted on geotech samples. Total uranium and isotopic uranium analysis are being collected from different depths to define the vertical and horizontal distribution of uranium in the soil of the study area. This is presented in the text.

Action: TCLP analysis for the geotechnical borings have been deleted from Table 8-6.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: Table 8-6 Page #: 8-10 Line #: NA Code:
Original Specific Comment #: 16

Comment: Because consolidation tests are typically performed to estimate settlement, samples for consolidation testing should be collected from below the anticipated base level. If the lower Proctor sample depth shown in Table 8-6 represents the base level, one-half of the consolidation tests would be above the base level. The reason for testing samples potentially above the base level should be given.

Response: Agreed.

Action: Table 8-5 (was Table 8-6) has been revised to reflect that the consolidation tests will be on sets from the gray soil, these soils will definitely be below the anticipated base level.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: Table 8-6 Page #: 8-10 Line #: NA Code:
Original Specific Comment #: 17

Comment: See original specific comment #6 on Page 8-2. The number of samples for each boring in Table 8-6 needs to be summarized and used to prepare Table 8-1. The revised text and tables should agree.

Response: Agreed.

Action: Table 8-1 has been corrected to summarize Table 8-5 was Table 8-6.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: Table 8-6 Page #: NA Line #: NA Code:
Original Specific Comment #: 18
Comment: The format presenting the depth of "brown" and "gray" clay in Table 8-6 (first and second columns) is confusing. For example, Locations 11468 through 11471 show two successive "gray clay depths while Locations 11472 through 11481 show only one "gray" clay depth. The table should more clearly present data regarding brown and gray clay layers.
Response: Agreed.
Action: Table 8-5 (was 8-6) has been revised by deleting the successive depths.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: Table 8-6 Page #: 8-14 Line #: NA Code:
Original Specific Comment #: 19
Comment: The text referring to "2 Task Manager" in the footnote is not clear and this individual is not in Figure 4-1. The meaning of this footnote should be clarified.
Response: Agreed.
Action: The footnote has been deleted.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: Table 8-6 Page #: 8-15 Line #: NA Code:
Original Specific Comment #: 20
Comment: Locations 11491 through 11505 are new piezometer nests. Typically, nested piezometers are not drilled to the same depth. Here 15 nested piezometers are all drilled to 20 feet (maximum 30 feet according to page 8-25, line 14). The rationale for having the same depth for all three piezometers at each nested location is not provided but should be. Also, these piezometers are called wells on page 8-25, line 14. This discrepancy should also be addressed.
Response: Agreed. The depths for these wells are estimates. The actual depths will vary for each nest and will be determined in the field in conjunction with cone penetrometer data.
Action: The text on Page 8-23, lines 22, 23, and 24 have been changed to the following: "The locations of these wells have been selected using a 3D model which was generated from the Sitewide Environmental Database and CPT data."

Commenting Organization: U.S. EPA Commentor: Saric
Section #: Table 8-7 Page #: 8-16 Line #: NA Code:
Original Specific Comment #: 21
Comment: This table lists sample volumes, containers, and preservatives required for soil samples. However, it does not provide any information on sample volume for standard Proctor tests. This test generally requires a large volume of sample material, and obtaining this volume at depth may be difficult unless the borings are drilled with augers. The last parameter listed in Table 8-7 uses the phrase "consolidated undrained;" however, the word "triaxial" should be added to be consistent with Table 8-1. Also, "hydraulic conductivity" should be called "permeability" to be consistent with Table 8-1, or the table should be changed to be consistent with American Society for Testing and Materials (ASTM) terminology.

Response: The borings will be drilled with augers; therefore, sample volume is not a problem. Standard Proctor tests have been collected for prior geotech activities using the same method planned for this activity.

Action: "Triaxial" has been added to Table 8-6 (was Table 8-7). Permeability was also been added.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.2.3 Page #: 8-18 Line #: NA Code:
Original Specific Comment #: 22

Comment: This page was not found in the copy received for review. If this page is not needed, the remainder of Section 8.0 should be repaginated. In addition, several tables in Section 8.0 were not paginated. These pages should be paginated to minimize confusion.

Response: Agreed.

Action: Section 8 has been repaginated.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.2.4.2 Page #: 8-19 Line #: 24 Code:
Original Specific Comment #: 23

Comment: The text states that two on-site locations and one off-site location will have three nested lysimeters each. Figure 8-1, however, shows that the proposed three nested lysimeter locations are all on site. Without one off-site location, it will not be possible to determine the background uranium concentration in vadose zone, as stated in Table 3-1. This discrepancy should be corrected.

Response: Agreed.

Action: Figure 8-1 has been changed.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: Figure 8-1 Page #: 8-20 Line #: NA Code:
Original Specific Comment #: 24

Comment: According to this figure, the proposed locations of cone penetrometers, nested lysimeters, and nested piezometers appear to adequately cover the east side of the study area (east of the north access road). However, no proposed investigation activities are shown for the northwest portion of the study are (except for one well or piezometer nest) or for the southwest portion of the study area. The text should present the rationale for not conducting investigation activities for these two areas.

Response: The 3-D uncertainty modeling was conducted using all of the available Sitewide Environmental Database (SED) data. The modeling was used to select the CPT locations. With additional information from the CPT's, further modeling was conducted and the subsequent results were used to select the well, lysimeter, and geotechnical locations.

Action: The following text has been added to Page 8-7, line 18: "The 3-D uncertainty modeling was conducted using all of the available Sitewide Environmental Database (SED) data. The modeling was used to select the CPT locations. With additional information from the CPT's, further modeling was conducted and the subsequent results were used to select the well, lysimeter, and geotechnical locations."

The following text has been added to Page 8-17, line 18: "The 3-D uncertainty modeling was conducted using all of the available Sitewide Environmental Database (SED) data. The modeling was used to select the CPT locations. With additional information from the CPT's, further modeling was conducted and the subsequent results were used to select the well, lysimeter, and geotechnical locations."
The following text has been added to Page 8-23, line 15: "The 3-D uncertainty modeling was conducted using all of the available Sitewide Environmental Database (SED) data. The modeling was used to select the CPT locations. With additional information from the CPT's, further modeling was conducted and the subsequent results were used to select the well, lysimeter, and geotechnical locations."

Commenting Organization: U.S. EPA Commentor: Saric
Section #: Figure 8-1 Page #: 8-20 Line #: Na Code:
Original Specific Comment #: 25
Comment: This figure shows 31 CPTs, but one of them, near the southern end of the study area, is shown as location 11468, which is also indicated as a new boring in Tables 8-1 and 8-6. Also, location 11453 is missing from the sequence of numbers for the CPTs in Figure 8-1. These discrepancies should be addressed.
Response: Agreed.
Action: Figure 8-1 has been updated to reflect the correct CPT locations.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.2.4.3 Page #: 8-23 Line #: 9 Code:
Original Specific Comment #: 26
Comment: The text states that lysimeter pressure should be slowly increased until it reaches 9 psi to lift the sample into the lysimeter. The proposed TIMCO lysimeter to be used for the study specifies 0.44 psi pressure for each foot of depth and 9 psi for 20 feet to lift the sample into the holding chamber of the lysimeter. The possibility of using 9 psi pressure for 35 and 55 feet should be verified with the manufacturer and should be explained.
Response: Agreed.
Action: The reference to 9 psi has been removed.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.2.4.3 Page #: 8-23 Line #: 18 Code:
Original Specific Comment #: 27
Comment: The text states that the final round of lysimeter sampling, which will be at equilibrium, will be analyzed for total uranium, isotopic uranium, bromide, calcium, magnesium, alkalinity, nitrates, and sulfates. However, the parameters listed in Table 8-2 are not consistent with this statement. The text and Table 8-2 should be consistent.
Response: Agreed.
Action: The text and tables have been made consistent.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.2.4.3 Page #: 8-24 Line #: 28 Code:
Original Specific Comment #: 28
Comment: The text states "In addition to sampling the newly installed lysimeters, lysimeters 11132, 11133, 11130, and 11131 will be samples for..." Figure 8-1 shows the locations of lysimeters 11133 and 11130, but the locations of lysimeters 11131 and 11132 are not shown. These locations should also be shown in Figure 8-1.
Response: Agreed.
Action: Figure 8-1 has been revised.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.4.1 Page #: 8-30 Line #: 3 Code:
Original Specific Comment #: 29
Comment: The text mentions that only soil sampling equipment will be cleaned by rinsing with deionized water. The text should clarify if water sampling equipment will also be cleaned and by what method.
Response: This section only discusses Field QC sample collection. Sample Equipment cleaning is not addressed in this Section. It is addressed in Section 8.4.4.
Action: No action.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.4.2 Page #: 8-31 Line #: 15 Code:
Original Specific Comment #: 30
Comment: The text in this section mentions the Operable Unit 2 project manager, but this position is not listed in Figure 4-1. It is unclear if this refers to the director of the operable unit. The text or the figure should be revised.
Response: Agreed.
Action: The text has been changed to "Sitewide Disposal Facility Project Manager".

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.4.6 Page #: 8-32 Line #: 15 Code:
Original Specific Comment #: 31
Comment: The text states that collection of soil and subsoil materials will be documented in several forms, including a Subsurface Soil Sample Collection Log. However, no such log is found in Attachment IV. It is possible that the Sample Collection Log may be used instead. Either the missing form should be included or the text should be revised accordingly.
Response: Agreed.
Action: The text on page 8-32, line 19 has been changed to "Sample Collection Log".

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.7 Page #: 8-36 Line #: 3 Code:
Original Specific Comment #: 32
Comment: Some of the analytes of interest listed here (for example, chloride) are not presented in Table 8-7. This information should be provided.
Response: Agreed.
Action: The Table and text have been revised to be consistent.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.8.2 Page #: 8-36 Line #: NA Code:
Original Specific Comment #: 33

Comment: This section on the determination of distribution factors (K_d) for uranium in FEMP soil and groundwater contains all relevant factors. However, it omits most of the necessary specifics, such as the equation for K_d and how the experimental results will be used to solve the equation. More details should be provided.

Response: The equation for K_d is given in the DQO in Attachment II.

Action: Text has been added to Page 8-37 referencing the Attached DQO.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.8.2 Page #: 8-36 Line #: 21 Code:
Original Specific Comment #: 34

Comment: In this section and in Table 8-9, the document cites "standard adsorption tests and desorption tests." However, the specific standard is never cited. If the standard tests are published or vary from the published tests (such as Standard Test Method for Determination of a Sorption Constant for an Organic Chemical in Soil and Sediments," ASTM Method E-1195), a citation, and brief summary of the differences between the tests will suffice. If the standard tests are not published, FEMP should include the laboratory's standard operating procedures or a comparable document.

Response: The ASTM reference will be added to this sentence.

Action: The following text will be added, "Fourteen standard adsorption tests and desorption tests, and desorption tests, following ASTM Method D-4319-83..."

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.8.2 Page #: 8-37 Line #: 3 Code:
Original Specific Comment #: 35

Comment: The text states that "speciation studies have shown..." The references for these studies should be provided.

Response: Agreed.

Action: The text discussing speciation has been removed.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.8.2 Page #: 8-38 Line #: 26 Code:
Original Specific Comment #: 36

Comment: Because the term "duplicate" is used here but "split" is used in Table 8-9, the meaning is confusing. It would be better to use the same term throughout the text discussing Kd testing, if appropriate. The text should be revised accordingly.

Response: Agreed.

Action: "Duplicate" has been changed to "split".

Commenting Organization: U.S. EPA Commentor: Saric
Section #: Table 8-9 Page #: 8-40 Line #: NA Code:
Original Specific Comment #: 37

Comment: This table refers to standard methods but does not identify the specific standard methods being referred to. In addition, this table should clarify whether a given portion of a soil sample will be used in two or more experiments. If sample portions are reused, the order during which the experiments will be performed is a critical variable. If sample portions are not reused, then the selection of the samples for the various tests is critical. Moreover, the rationale for using gray clay, but not brown clay, for the series of studies should be provided. Finally, the unbalanced design (seven brown clay samples but only four gray clay samples in the primary test) should be explained.

Response: Agreed.

Action: Table 8-9 has been replaced with a new Table 8-9 which addresses the comment.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: Table 8-10 Page #: 8-41 Line #: NA Code:
Original Specific Comment #: 38

Comment: There appears to be no correlation between the samples in Table 8-10 and the tests listed in Table 8-9. A single table, combining contents of these two tables, would be less confusing. Also Section 8.8.2 notes that many factors such as carbonate and phosphate concentrations, pH, and other chemical factors can affect the observed sorption phenomena. The parameters should also be monitored.

Response: Agreed.

Action: Tables have been modified to show correlation with 8.8.2.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.9 Page #: 8-44 Line #: 31 Code:
Original Specific Comment #: 39

Comment: The text states that the contract performance requirements will be identified in the PSP. It is not clear if the referenced PSP is the one that is being reviewed or whether the performance requirements will be identified in the final PSP. The text should be revised to clarify this point, as well as identify the performance requirements.

Response: The contract performance requirements are not to be identified in this PSP.

Action: The reference to contract performance requirements has been deleted.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.9 Page #: 8-45 Line #: NA Code:
Original Specific Comment #: 40

Comment: Some of the acronyms are not defined and some do not match their definitions in Figure 4-1. The acronyms should be defined and used consistently.

Response: Agreed.

Action: The acronyms have been defined and match figure 4-1.

6481

PROJECT SPECIFIC PLAN

FOR PHASES I AND II OF THE

OPERABLE UNIT 2

PRE-DESIGN FIELD INVESTIGATION

RI/FS WBS NUMBER 20.03.07

REVISION 0

JANUARY 10, 1995

Prepared by

Fernald Environmental Restoration Management Corporation

Prepared for

U.S. Department of Energy
Fernald Field Office

000014

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont.)

TABLE OF CONTENTS (Cont.)

TABLE OF CONTENTS (Cont.)

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

The preferred remedial alternative for Operable Unit 2 includes an on-site disposal of remediation material. The design of a disposal facility is required as part of these remedial action plans. No. 1 Also, the design will include accepting other waste materials generated from site-wide remediation. Initial screening for an acceptable location for the disposal facility was performed using available environmental sampling data. This data was evaluated by using an uncertainty kriging model to determine if enough data was available to ensure accurate geological predictions. The model results indicated that an unacceptable uncertainty existed in predicting lithologies for locating a disposal facility. ~~As a results~~ Consequently, this Pre-~~Design~~ Investigation for determining the location of the on-site disposal facility was developed.

The purpose of the Pre-~~Design~~ Investigation is to define the most suitable location of the disposal facility within an identified best area at the Fernald Environmental Management Project (FEMP) based on Operable Units 2 and 5 Remedial Investigation/Feasibility Study (RI/FS) investigations. The identified best area is located on the east side of the FEMP and measures approximately 2000 feet east to west by 5300 feet north to south (see Figure 1-1). This area is considered the best location for an on-site disposal facility primarily based on the greatest thickness of gray clay which provides a protective layer over the Great Miami Aquifer. Fate and transport modeling and risk assessments in the Operable Unit 2 Feasibility Study (FS) report have shown that a disposal facility in this area, based on a feasible facility design and a 12-foot gray clay layer, will be protective of human health and the environment.

The boundary of the study area, identified on Figure 1-1, has been bounded on the north, east, and south by the Ohio Environmental Protection Agency (OEPA) siting requirements (buffer from property line and water supply wells). The west boundary follows the 12 feet of gray clay contour line with the exception of the northern portion of the west boundary line (above the ~~p~~Production ~~a~~Area), which was made based on identification of sand lenses within the gray clay.

Based on planning meetings with the Department of Energy (DOE), Fernald Environmental Restoration and Management Corporation (FERMCO), United States Environmental Protection Agency (U.S. EPA), and OEPA, the Pre-~~Design~~ Investigation includes three objectives. The first

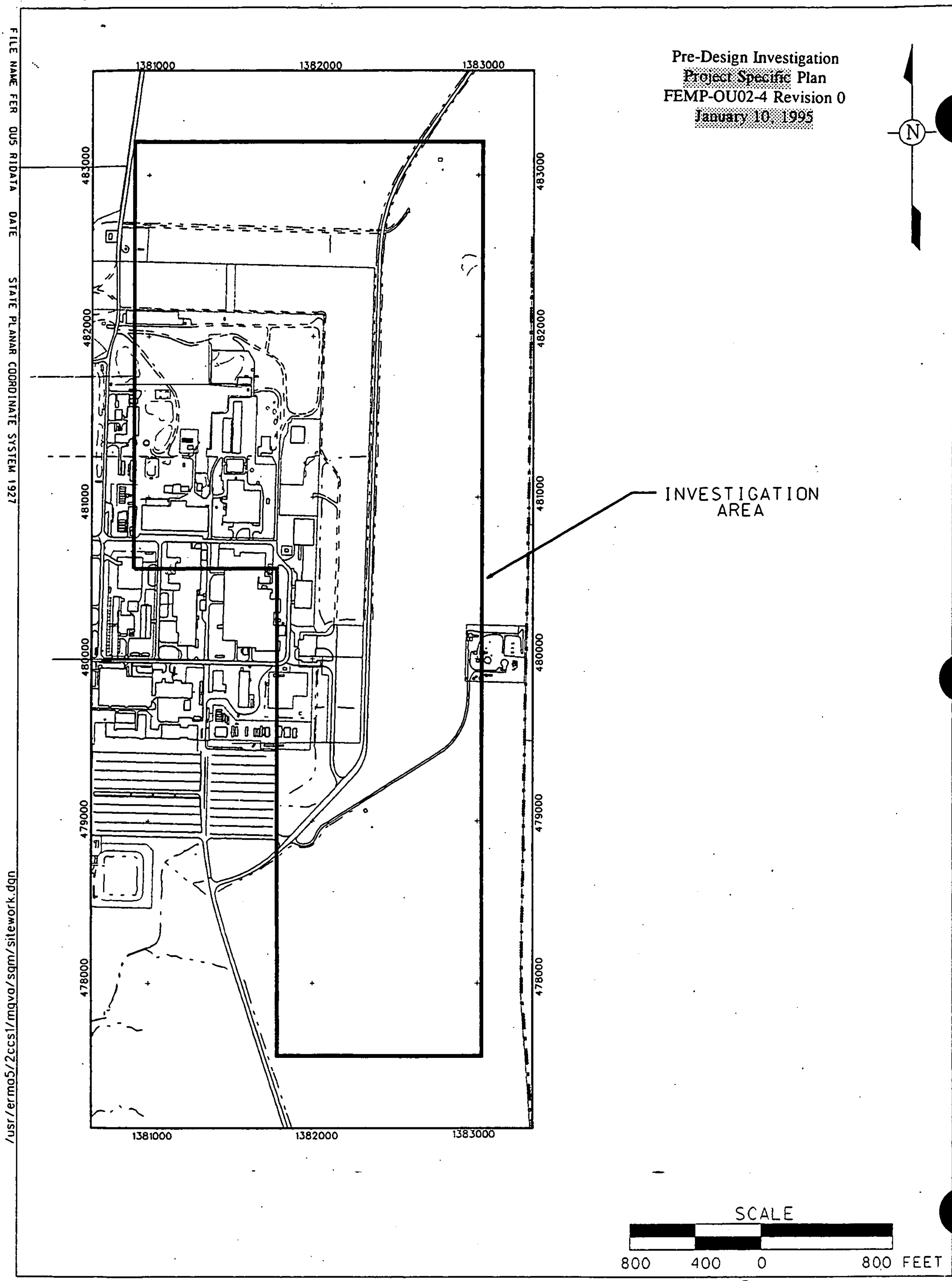


FIGURE 1-1. PROPOSED INVESTEGATION AREA

objective is to identify the most suitable hydrogeology in this identified best area on site. The field components involve verification of the ~~thickest~~ gray clay thickness and the identification of interbedded granular material. The second objective is the verification analysis of the protection of human health and the environment. The field components include verification of (1) existing vertical and horizontal uranium contamination; (2) solubility of uranium present; (3) retardation of uranium; (4) lateral and vertical gradients; and (5) background concentrations of uranium of water in the vadose zone (background lysimeters). The third objective is to develop field information for the design of the disposal facility. The field components include location and extent of any interbedded granular material and geotechnical information in the footprint of the disposal facility.

The Pre~~-Design~~ Investigation fieldwork will be preformed in a phased approach. The first phase will include preliminary cone penetrometer testing (CPT) and water level measurements of existing wells. This information will be used to better plan the sampling locations during the second phase. The second phase will include the collection of data to identify the facility footprint which will include the verification of protection of human health and preliminary geotechnical sampling. The third phase will be to collect the detailed geotechnical data from the facility footprint needed for the design of the facility.

Information from previous investigations pertaining to the study area was analyzed as a first step in developing this plan. Lithological data records were compiled into a block model and, by the means of kriging, the level of certainty in knowing where interbedded granular areas exist was evaluated. This analysis served as the basis for identifying locations for Phase I and preliminary locations for the Phase II.

The scope of work identified in this plan is for Phases I and II of the Pre~~-Design~~ Investigation fieldwork. The scope of work for the Phase III investigation will be submitted in a separate plan.

2.0 SUMMARY OF PREVIOUS INVESTIGATIONS

Existing FEMP reports were reviewed to obtain information that would be useful in locating the disposal facility and/or in planning this Pre-~~Design~~ Investigation. The reports reviewed are listed in Table 2-1.

TABLE 2-1

SUMMARY OF REPORTS REVIEWED DURING WORK PLAN PREPARATION

Author	Date	Report
Westinghouse	April 1990	"Conceptual Design Report - Above-Ground Engineered Storage (AGES)"
Parsons	December 1990	"Pre-Conceptual Design Study - On-Site Low-Level Waste Disposal Facility"
Parsons	March 1992	"Conceptual Design Report for the Engineered Waste Management Facility"
~~U.S. Dept. of Energy (~~DOE~~)~~	June 1993	"Technical Report 5.1A, Engineering Evaluation Report for On-Site Disposal"
~~U.S. Dept. of Energy (~~DOE~~)~~	June 1993	"Technical Report 5.1B, Site Characterization/Geological Report for On-Site Disposal"
Parsons	March 1994	"On-Site Waste Disposal Cell Pre-Design Activities Engineering Report"
Parsons	May 1994	"FEMP Glacial Till/Vadose Zone Hydraulic Investigations Report - Operable Unit 5"
~~U.S. Dept. of Energy (~~DOE~~)~~	June 1994	"Remedial Investigation Report for Operable Unit 5," Volume 1 of 5

Of these reports, four reports and the Site-~~W~~wide Environmental Database (SED) were found the most useful in obtaining data to plan the proposed work. These reports are:

No. 2

- "The FEMP Glacial Till Report" ~~(DOE, 1994)~~ (Parsons, 1994)
- "The On-Site Waste Disposal Cell Pre-Design Activities Engineering Report" (Parsons, 1994)
- Technical Report 5.1B, "Site Characterization/Geological Report of On-Site Disposal"

(DOE, 1993)

- "The Draft Remedial Investigation Report for Operable Unit 5 at the FEMP" (DOE, 1994)

The "FEMP Glacial Till/Vadose Zone Hydraulic Investigations Report - Operable Unit 5" (Parsons, 1994) provides information on two lysimeters installed ~~close to~~ in the study area. One is at the north edge of the area and one is within the south part of the investigation site (see Figure 8-2). These lysimeters will be re-sampled during the Pre~~-Design~~ Investigation.

The report "On-Site Waste Disposal Cell Pre-Design Activities Engineering Report" (Parsons, 1994) focused on the southwest corner of the current study area. Technical Report 5.1B "Site Characterization/Geological Report of On-Site Disposal" (DOE, 1993) provided data concerning geological and geotechnical engineering characteristics on the north and east boundaries of the current study area. Data from these investigations were incorporated in an uncertainty analysis using solid block modeling.

The "The Draft Remedial Investigation Report for Operable Unit 5 at the FEMP" (DOE, 1994) contained interpretations of stratigraphy and boring/well log data that was used in the development of the solid block model and in preparation of the ~~W~~work ~~P~~plan.

These existing studies, as well as miscellaneous monitoring activities undertaken during remedial investigations, have provided ~~greater~~ more than 150 borings/wells within the boundaries of the study area.

The present work plan is based upon the existing data gathered from these reports in the following ways:

1. Thickness maps of brown and gray till, based upon existing data, are used to plan total depths for sampling;
2. Existing data are used to construct a 3-dimensional kriged model of the site geology;
3. The kriged model of the site geology is used to estimate the uncertainty of the current data on location and extent of sand units within the till; and
4. The location for future samples will be guided by the need to reduce uncertainty about the

location of sand within the till.

The 3-dimensional kriged model was developed using existing lithological data records within the brown and gray clay within the study area. These records were converted into a 0/1 indicator variable, where a value of 1 was assigned to records designated as "sand" or "gravel". All other records were assigned a value of zero. A block model was created with the following parameters (measurements in feet):

Easting Range 1,380,900-1,383,100 (1927 State Planar)

Northing Range 477,500-438,200 (1927 State Planar)

Elevation Range 548-616 (mean sea level [MSL])

Block Size 100(East) x 100(North) x 1 Elevation

A statistical distribution of the 0/1 variable was estimated for each block in the model using indicator kriging. Based on a sand/nonsand decision point of 0.5, and the 0/1 distribution assigned to each block, a new variable was calculated to represents the probability that a block being above the decision point of 0.5 and marked as a "sand" block. Using this new variable, areas were defined where there is a greater than 5% probability that the sand units are present. Conversely, the inverse of these areas represent the areas where, with a 95% confidence, there are no sands present.

The distribution that indicator kriging assigns to each block is defined by the two parameters: the mean value and the standard deviation of the distribution. The mean value is primarily influenced by the ratio of 0s and 1s in the nearby samples. The standard deviation is primarily influenced by the quantity and spatial nature of the samples around the block. As coverage of the samples around a block increases, the standard deviation decreases and vice versa.

Areas where the sample data is biased towards 0s or 1s are denoted as having "consistent" data. Areas where the sample data has a mixture of 0s and 1s are denoted as having "inconsistent" data. Using this terminology, four types of areas are defined for locating additional sampling:

TABLE 2-2

UNCERTAINTY OF KRIGED ESTIMATES

Data Type	Many Samples	Few Samples
Consistent-~~data~~	Type I: well understood and homogeneous	Type II: not well understood and possibly homogeneous
Inconsistent-~~data~~	Type III: well understood and heterogeneous	Type IV: not well understood and possibly heterogeneous

Type II and IV areas have been considered in this plan for additional sampling. Confirmation sampling is recommended for Type I areas and no additional sampling is recommended for Type II areas. A preliminary determination of the study area has been made based on existing data and presented to EPA and OEPA during a planning meeting. The Phase I CPT information will be added to this uncertainty analysis prior to planning the specific Phase II sampling locations.

3.0 DATA QUALITY OBJECTIVES AND QA/QC REQUIREMENTS~~, AND SAMPLING PLAN~~

3.1 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are quantitative and qualitative descriptions of the data required to fulfill the purposes of the sampling effort. This section presents the results of the DQO development process for this Operable Unit 2 sampling activity. The process determines the necessity of sample collection, sample types, location and number of samples, and analytical requirements.

3.1.1 Purposes of Sampling Effort

The ~~data quality objectives~~ DQOs and sampling activities are intended to satisfy the following overall purposes:

Verify the most suitable geology and hydrogeology for the disposal facility with the identified best area.

- Identify the thickest gray clay.
- Identify interbedded granular material.
- Define areas that are relatively geologically homogeneous, so that specific tests of the soil and water can be related to known volumes of media in the study area.

Collect samples to verify values used in groundwater fate and transport models in the Operable Unit 2 (OU2) and Operable Unit 5 (OU5) FSs.

- Verify existing vertical and horizontal uranium contamination.
- Determine the solubility of the uranium present.
- Determine the soil retardation of uranium.
- Identify the vertical and lateral perched groundwater gradient.
- Determine the background uranium concentration in the vadose zone water

Develop initial information for design of the disposal facility.

- Identify the initial geotechnical properties of the soil.

3.1.2 Development of ~~Data Quality Objectives~~ DQOs and Sampling Plan

Separate DQOs were developed for (1) ~~cone penetrometer testing~~ CPT, (2) geotechnical sampling, and (3) the chemical water, ~~and~~ soil sampling, the nested well sampling and analysis, K_d sampling, and the lysimeter sampling and analysis. These DQOs were developed using the following steps:

- The problem statement
- The decision
- Inputs that affect the decision
- Boundaries of the study
- The logic statement
- Constraints on the uncertainty of the decision
- Obtaining quality data
- Summary

Specific DQOs for this Project Specific Plan (PSP) were developed and are presented in Attachment I. Data requirements and corresponding sampling activities are presented in Table 3-1.

3.2 ASSIGNMENT OF EXISTING ANALYTICAL DQOs

One of five ~~Fernald Environmental Management Project (FEMP)~~ defined analytical support levels (ASLs) are assigned to all data to be collected depending on the intended use of the data. For this plan, the ASLs ~~levels~~ for each type of analysis is provided in Table 3-2.

The specific definitions of the five ASLs ~~levels~~ (A through E) are provided in the FEMP Site-~~W~~wide CERCLA Quality Assurance Project Plan (SCQ) and are summarized in Table 3-3.

3.3 QA/QC REQUIREMENTS

~~Sampling events follow Quality Assurance/Quality Control (QA/QC) protocol established in Section 4 and Appendix K of the SCQ, and EPD internal procedure EP-SMS-002, "Field Quality Control Samples."~~

Activities shall be performed in accordance to SCQ requirements.

~~The frequency and number of field QA/QC samples collected are based on the applicable DQOs and the CPID. Requirements and justification for collection of field QA/QC samples per sampling round shall be documented in this Pre-Design Investigation Project Specific Plan (PSP). Applicable Required laboratory QC sample types and frequency requirements are provided in Appendix G of the SCQ.~~

3.3.1 Project Requirements for Self-Assessments, Surveillances

Self-assessment and independent assessments of work processes and operations shall be undertaken to assure quality of performance. Self-assessment shall be performed by the Environmental Division, shall encompass technical and procedure requirements, and may be conducted at any point in the project.

TABLE 3-1

DATA REQUIREMENTS AND PROPOSED SAMPLING ACTIVITY

Basis for Data Requirement	Proposed Sampling Activity
Verify the ~~thickest~~ gray clay thickness Define the location and extent of sand lenses, and collect additional data using the least obtrusive method possible. Locate areas that contain relatively homogeneous geological conditions and obtain the least number of samples required to characterize the required properties of the clay and sand.	Define locations for required data by using a kriged 3-D model of sand and the uncertainty of the current model of sand. Locate first phase of sampling within areas of highest uncertainty. Utilize cone penetrometer sampling to minimize damage to the clay and define areas of relatively homogenous geology. Use soil sampling with an auger to confirm CPT interpretations and collect ~~analyze~~ soil samples for analysis. Characterize soil borings to locate areas of sand. Perform water level measurements of existing and new wells to perform inverse modeling to assist in determining connectivity of sands.
Verify existing vertical and horizontal uranium contamination and solubility.	Collect soil samples from the brown and gray clay for total uranium and TCLP uranium analyses. Install nested lysimeters and collect water samples. Analyze samples for chemistry, radio-isotopes and evaluate the apparent age of water.
Verify the ability of the brown and gray clay to retard the migration of uranium.	Collect batch samples from the brown and graey clay for the partitioning coefficient (K_d) analysis.
Measure the vertical and lateral hydraulic gradient and permeability of the till to estimate vertical percolation of water.	Drill and install nested wells to measure hydraulic gradient in brown ~~till~~ and gray till. Undisturbed cCore samples from the borings will be tested for ~~have~~ permeability~~ measured. Use these data to estimate the potential velocity of water.~~
Determine the background uranium concentration in the vadose zone	Install nested lysimeters in a background area and collect water samples for total uranium analyses.
Identify initial geotechnical properties of the soil	Drill borings and take samples for preliminary geotechnical sampling.

TABLE 3-2

ANALYTICAL SUPPORT LEVEL FOR THE PRE-~~DESIGN~~ INVESTIGATION

Type of Analysis	Analytical Support Level
Cone Penetrometer	B
Water:	
General Chemistry/Inorganics	B
Radiological (except Tritium)	D
Tritium	E
Silica - Radiological	D
Soil:	
Radiological	D
Geotechnical	B

Note: General Chemistry includes alkalinity, carbonate, phosphate, nitrate/nitrite, and sulfate. Inorganics include chloride, bromide, and magnesium.

TABLE 3-3

ANALYTICAL SUPPORT LEVELS

Support Level	Description	Typical Data Uses
A	*Qualitative Field Analysis* - This level is characterized by the use of portable instruments that can provide real-time data to assist in the optimization of sampling point locations and in providing health and safety support. Data can be generated regarding the presence or absence of contaminants (e.g., radionuclides, volatiles) at sampling locations. Analogous to Environmental Protection Agency (EPA) analytical level 1.	• Site characterization • Monitoring during implementation
B	*Qualitative, Semi-Quantitative, and Quantitative Analyses* - This level may include the use of more sophisticated screening techniques, such as portable analytical instruments that can be used on-site (close-support laboratories). Depending upon the types of contaminants, sample matrix, and QC checks applied, qualitative and quantitative data can be obtained. Analogous to EPA analytical level 2.	• Site characterization • Evaluation of alternatives • Engineering design • Monitoring during implementation
C	*Quantitative with fully defined QA/QC* - Laboratory analyses generated with full QA/QC checks of types and frequencies specified for ASL D according to FEMP-specified analytical protocols for radiological and nonradiological parameters. The analytical methods are identical to ASL D for QA/QC sample analysis and method performance criteria. However, the data package does not typically contain raw instrument output but does include summaries of QA/QC sample results. ASL C may be used when analyses require a rigid, well-defined protocol, but where other information is available, so that a complete raw data package validation effort is not required. Laboratories are required to retain, in the project file, raw instrument data to upgrade ASL C reports to ASL D. Analogous to EPA analytical level 3.	• Risk assessment • Site characterization • Evaluation of alternatives • Engineering design • Monitoring during implementation
D	*Confirmational with complete QA/QC and reporting* - Provides data generated with a full complement of QA/QC checks of specified types and frequencies according to FEMP-specified analytical protocols for radiological and nonradiological parameters. The data package includes raw instrument output for validation. These data may be used to confirm data gathered at ASLs B and C, and when full validation of raw data is required. Analogous to EPA analytical level 4.	• Risk assessment • Evaluation of alternatives • Engineering design
E	*Nonstandard* - Analyses by nonstandard protocols that often require method development or validation (e.g., when extracting detection limits or analysis of an unusual chemical compound is required). New methods may be developed for ASL E data to allow for parameters or matrices that cannot be analyzed by existing standard methods. Analogous to EPA analytical level 5.	• Risk assessment

Independent assessment shall be performed by the ~~FEMP~~ Environmental QA organization by conducting surveillances. As a minimum, one surveillance shall be conducted, consisting of monitoring/observing on-going project activity and work areas to verify conformance to specified requirements. Surveillances shall be planned and documented in accordance with Section 12.3 of the SCQ.

3.3.2 Field QA/QC Samples

Field QA/QC samples will consist of duplicates ~~(soil and groundwater)~~, field blanks ~~(groundwater)~~, and equipment rinsates ~~(groundwater)~~. The collection of field QA/QC samples are discussed further in Section 8.0.

One rinsate sample per 20 soil samples collected will be prepared and analyzed for total and isotopic uranium ~~during soil sample collection~~ or as required in the SCQ Appendix A, Table 2-4. One rinsate sample ~~per 20 samples~~ per groundwater sampling round~~, whichever is more frequent,~~ will be collected ~~during groundwater sampling~~ and ~~will be~~ analyzed for inorganics/general chemistry and total and isotopic uranium.

A duplicate sample will be collected for every round of water sample collection, or 1 in 20 water samples, whichever is greater, the duplicate will be analyzed for general chemistry/inorganics, total and isotopic uranium, and tritium (Table 3-2). ~~One soil chaining duplicate shall be collected from every seventh boring.~~

A field blank will also be prepared during water sample collection at each location at 1 in 20 samples or one for each round of sampling, whichever is more frequent, and analyzed for inorganics, general chemistry, and total and isotopic uranium.

One ~~Cone Penetrometer Testing (~~CPT~~)~~ duplicate will be tested for every tenth CPT ~~location~~ tested.

~~One field blank shall be prepared at each day of sampling at each location of sampling in accordance with Section K.4.6 of the SCQ. The sample containers containing organic free de-ionized water will remain open during sampling activities at each location.~~

3.3.3 Field Changes to the PSP

Field changes to the PSP are at the discretion of the field geologist, sampling technician, and/or the Pre-~~Design~~ Investigation Task Manager ~~Project Engineer~~. Prior to implementation of the field changes, the Task Manager ~~Project Engineer~~ shall be informed of the proposed changes and the circumstances requiring the changes. Any changes to the activities specified in the PSP or the DQO must have the approval of the Task Manager ~~Project Engineer~~ and Quality Assurance prior to implementation. Changes to the program shall be documented on the applicable Variance Request Form within one week of verbal approval. Field changes to the sampling activities defined in this PSP may change the location or time of collection of sampling or add additional sampling locations. Scope changes to the PSP or DQO will require respective document revisions.

4.0 ORGANIZATION AND RESPONSIBILITIES

4.1 ORGANIZATION

This section describes the organizational and management structure to be used in implementing the Operable Unit 2 Pre~~-D~~design Work Plan at the FEMP. An Environmental Restoration Management Contract (ERMC) has been implemented at the FEMP site to manage the restoration activities, with Fernald Environmental Restoration Management Corporation (FERMCO). FERMCO~~,~~ reports~~ing~~ directly to the Department of Energy-Fernald Field Office (DOE-FN) ~~and, will~~ acts as the main contractor for FEMP activities and coordinator of technical support and remediation subcontractors. Under the current FERMCO organizational structure, Operable Unit 2 activities will be the responsibility of Comprehensive Environmental Response, Compensation, and Liability Act/Resource Conservation and Recovery Act (CERCLA/RCRA) Unit 2 (CRU2), with such activities being conducted by individuals of various disciplines matrixed to CRU2 from other FERMCO departments (see Figure ~~8~~ 4.1).

4.2 RESPONSIBILITIES

The major tasks that constitute the Operable Unit 2 Pre~~-D~~design Investigation organizational responsibilities to carry out those tasks are identified here. Primary responsibilities for implementing the Operable Unit 2 Pre~~-D~~design Work Plan will rest with Operable Unit 2 of the FERMCO organization, with additional necessary support provided through matrixing from other FERMCO departments and through subcontracts as appropriate to ensure quality and timeliness. Task-specific responsibilities will be implemented as follows:

1. Complete overall planning, integration, execution, and support of the Operable Unit 2 pre-design program. Implementation of these activities is the responsibility of the Environmental/Engineering Section matrixed to CRU2.

2. Prepare and obtain approval of Operable Unit 2 sampling and analytical procedures. Development of any new procedures will be the responsibility of the Planning Group within the Environmental/Engineering Section of CRU2. New procedures will be submitted to EPA for approval, as exceptions or addenda to the SCQ.

3. Prepare a ~~sampling and analysis plan (SAP)~~ PSP per CERCLA guidance for conducting field investigations, sampling, and analytical tasks. Each ~~SAP~~ PSP will be provided to the U.S. Environmental Protection Agency (EPA) and the Ohio Environmental Protection Agency (OEPA) for their review and approval before sampling activities are initiated.

4. Conduct the field program in accordance with the SCQ, established procedures, and the ~~SAP~~ PSP, including all aspects of monitoring, sampling, and shipment of samples. FERMCO's ~~Sample Collection/Data Management (SC/DM)~~ Site Characterization Department (SC) will provide the necessary matrixed support to CRU2 to ensure completion of these tasks. Parsons will provide technical oversighte and perform the geotechnical testing for geotechnical sample selection, analysis, and interpretation.

5. Review and validation of chemical data collected during field sampling/field characterization program will be conducted by the Data Quality Management Department of the Environmental Division ~~matrixed to CRU2, on an ongoing basis throughout the data collection and reporting processes~~. These tasks will be performed in accordance with the approved SCQ data validation procedures. Validated data will be entered into the FEMP ~~Site-Wide Environmental Database (~~SED~~)~~.

6. Assess and evaluate the field data to the requirements of ~~verify attainment of the data quality objectives~~ DQOs and ~~of~~ the Work Plan. Various facets of this task will be the responsibility of the Environmental/Engineering Section of CRU2, including the Pre-design Investigation Group, and the Data Management Group.

4.3 SAMPLE TEAM ORGANIZATION

4.3.1 Organizational Structure

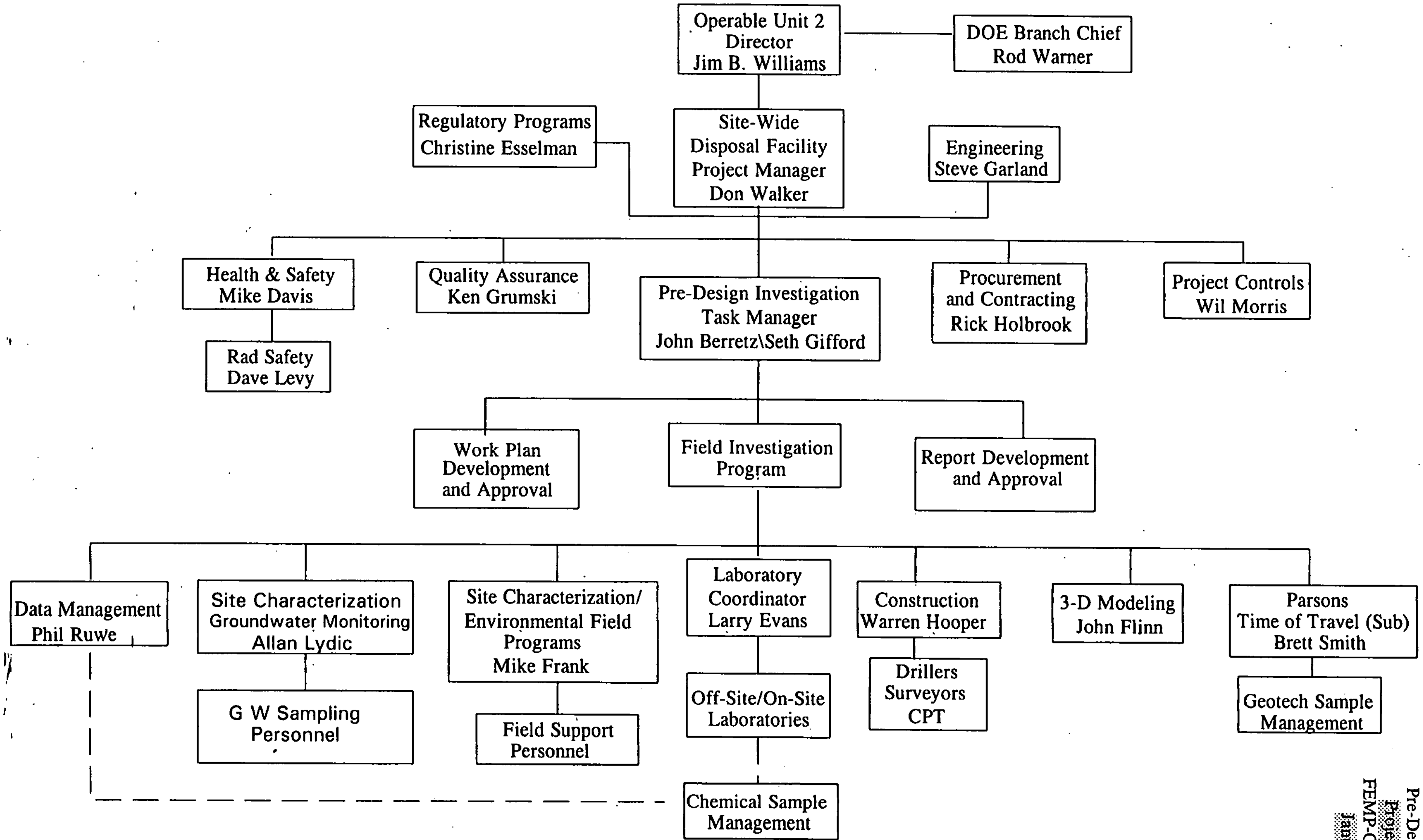
Sampling for this project will be performed by both Parsons and the Site Characterization Department of FERMCO. A schematic presentation of the organization is provided in Figure 4-1. Due to the nature, objectives, and programmatic requirements of this project, actual sampling locations and analysis parameter selection have been designated by FERMCO personnel of Operable Unit 2.

Parson's geotechnical personnel will be responsible for ~~retrieving~~ selecting geotechnical samples and producing the subsequent field boring logs. FERMCO personnel will be responsible for assisting in soil sample collection, well construction, water sample collection, and shipping of samples to the analytical lab.

Additional sampling custodian staff may be utilized to provide an interface between the sampling crews and the FEMP or contract laboratory to be used for sample~~ing~~ analysis.

FIGURE 4-1

PROPOSED ORGANIZATION
PRE-DESIGN INVESTIGATION



4.3.2 Responsibilities of Team Members

Overall project management will be provided by Mr. Don Walker, who is matrixed into CRU2. Reporting to him are the following functional groups:

- Regulatory Programs - responsible for assuring that the regulatory basis for the design is met by the proposed data collection

- Procurement/Contracting - Responsible for obtaining the required subcontract services

- Project Controls - Responsible for tracking costs and scheduling data

- Pre-~~D~~design Investigation Task Manager - Responsible for defining appropriate objectives for the program and reviewing data

- Engineering - Responsible for geotechnical testing and geotechnical data interpretation.

No. 3
- Quality Assurance - Independent of investigation activities and responsible for assuring field activities follow the identified procedures. Provide QA oversight of subcontractor activities.

Field sampling personnel from Environmental Field Programs are responsible for the collection of the samples in accordance with the approved ~~SAP~~ PSP. All activities associated with the execution of sampling are to be documented on the appropriate Field Activity ~~Daily~~ Logs (FA~~D~~Ls) which are to be completed, by the ~~sampling technicians~~ geologist, for each location. These technicians are also responsible for ensuring that the proper sampling equipment is available and in serviceable condition. Also, proper decontamination of equipment between each sampling point is the responsibility of these staff.

Additional sampling custodian staff who interface with the FEMP or contract laboratory are responsible for ensuring that proper sampling containers, preservatives, and sampling coolers are available and in serviceable condition.

Also, sample labeling, handling, storage, and ~~sample required paperwork in the form of~~ a Site-Wwide Analysis Request/Custody Record (SWAR/CR) Form to be completed prior to submittal to the appropriate FEMP or contractor laboratory for analysis, are the responsibility of the sampling custodian. Finally, sampling custodians are responsible for logging in all collected samples, delivering the samples to the FEMP laboratory or sending the samples, with accompanying paperwork, to the contract laboratory. These personnel are a part of the Environmental Field Operations ~~Programs~~.

4.3.3 Sampling Schedule

Sampling will be accomplished according to the schedule contained in the approved work plan and Section 9.0 of this ~~SAP~~ PSP. In general, sampling will be performed concurrent with other investigative activities such as well drilling or soil boring.

Groundwater sampling will consist of sampling nested wells or lysimeters. The new wells will be sampled following completion of well development.

5.0 HEALTH AND SAFETY ~~CONSIDERATIONS~~

The most successful methodology for providing an effective health and safety program for any activity is to ensure that involved personnel have received adequate training prior to implementation of the fieldwork. Employee awareness of all physical, radiological, and chemical hazards which may be encountered will be accomplished by training throughout the planning and execution of this project.

All FEMP employee and subcontractor personnel who will be performing fieldwork during this project will be required to have participated in all Occupational Safety and Health Administration (OSHA)-mandated 1910.120 Hazardous Waste Site Worker training. In addition, all applicable annual refresher training will have been taken by the individuals.

U.S. DOE regulations at the FEMP require a series of site-specific training courses. These courses are designed to augment OSHA required training and provide additional training specific to the hazards which exist at the FEMP.

Field personnel participating in the performance of this project will be trained to the SCQ requirements, the FEMP Health and Safety Plan~~,~~ and the ~~Task~~ Project Specific Health and Safety Plan~~s~~.

In summary, employee awareness and clearly delineated lines of authority and responsibility have been designed to provide for effective health and safety related knowledge specific to each activity.

5.1 TASK SPECIFIC PLANS

All aspects of this ~~Sampling and Analysis Plan~~ PSP will be performed in accordance with all existing applicable U.S. DOE, U.S. EPA, OSHA, and State of Ohio Health and Safety Regulations. Additionally, all practices will be managed in accordance with commonly accepted practices used in the hazardous waste industry.

No. 4

Prior to the implementation of fieldwork which involves cone penetrometer work, drilling, trenching, or soil boring, a Penetration Permit will be obtained. Before a Penetration Permit is obtained, the area of concern is investigated and compared against the site database for underground utilities in the area. No drilling, trenching or soil borings will be performed without a valid Penetration Permit being obtained prior to actual performance of the fieldwork.

Field activities ~~to be performed each have a separate task specific~~ require a health and safety plan. A ~~Task~~ ~~specific~~ health and safety plans ha~~s~~ve been prepared in accordance with the FEMP Site Health and Safety Plan. For each project task and subtask, health and safety technician coverage is provided by the assignment of a technician to monitor the activities of the field crew. ~~Project specific h~~Health and safety plans provide for the hazards typically encountered by personnel when performing the specified fieldwork.

~~Existing task specific health and safety plans to be utilized for this project include:~~

- ~~"Health and Safety Plan for Sampling of Wells and Surface Water Performed in Support of Sampling at the FEMP"~~
- ~~"Health and Safety Plan for Surface Sampling Tasks Performed in Support of Sampling at the FEMP"~~
- ~~"Health and Safety Plan for Well Drilling and Soil Boring Operations Performed in Support of Sampling at the FEMP"~~

Tasks not covered by the ~~existing~~ health and safety plans will have specific health and safety planning documents prepared, or existing documents will be revised as needed. Proper equipment to be used for health and safety monitoring and personnel protection are specified. Criteria for the selection of monitoring equipment and protective clothing are detailed.

Each member of the field crews is required to participate in a health and safety training session which is specific to each field project, prior to performance of this fieldwork.

5.2 RADIOLOGICAL MONITORING AND CONTROLS

Radiological monitoring for this work plan will be achieved using existing institutional controls commonly utilized at the FEMP. For those areas of the FEMP which are under existing institutional radiological controls, any employee who will be entering such areas is required to possess and wear a Thermoluminescent Detector (TLD) to monitor for exposure to radiological contamination. In addition, each employee is required to participate in a regularly scheduled urine analysis program which is designed to monitor for radiological exposure. However, radiological hazards are not expected to be encountered and spot monitoring will be required.

~~For areas which are subject to more restrictive radiological controls (i.e. the potential for exposure is greater), Radiation Work Permits are necessary and will be obtained prior to the fieldwork being performed in those areas. A radiological technician will be assigned to each field crew performing any activities in an area which could result in site workers being exposed to levels of radiological contamination exceeding DOE requirements.~~

~~Ingress and egress of personnel, equipment and vehicles to and from radiologically controlled areas will be monitored with "real time" radiation detection instrumentation.~~

Monitoring results, which exceed FEMP-determined exposure guidelines, will be further evaluated as to the possible source(s). Measures necessary to remediate radiological contamination sources will be implemented. Such measures may include, but are not limited to, personnel training, decontamination, employee exposure monitoring, increased personnel monitoring, ~~P~~personnel ~~P~~protective ~~E~~equipment, and sampling of suspect materials encountered.

If the responsible radiological technician assigned to the field activities ~~being performed~~ identifies a real or potential condition which could or will result in an unsafe condition, then that person has the responsibility to cease field operations until such time as the unsafe condition has been corrected.

5.3 NONRADIOLOGICAL MONITORING AND CONTROLS

Monitoring of potential health and safety problems associated with nonradiological hazards are evaluated by a health and safety technician. Also, all field crews are responsible for hazard awareness and recognition. Task-specific training is designed to enhance the performance of all fieldwork using good and safe work practices.

Evaluating the potential for personnel exposure to organic contaminants will be achieved mainly through the use of ~~an HNu PI 101~~ Photoionization Detector. Other equipment which could potentially be used includes ~~Drager tubes,~~ oxygen meters, and combustible gas indicators. Proposed work in the East Area will be undertaken using protective level D, since the area is not a radiologically controlled area.

6.0 QUALITY ASSURANCE AND QUALITY CONTROL

The primary objectives of the QA/QC sections of this plan relate to the collection of field information needed to select a preferred location for the footprint of a 2.5 million cubic yard capacity disposal facility. Specific objectives of this field sampling effort will be designed, organized, and implemented in a manner which will optimize the collection of information which meets predetermined ~~data quality objectives~~ DQOs. To ensure that information is gathered in such a manner that ~~data quality objectives~~ DQOs are met, QC measures will be used to determine conformance with overall program objectives. ~~Cone penetrometer testing is not covered under the SCQ.~~

The fundamental mechanisms ~~that will be~~ used to achieve these project quality goals can be categorized as prevention, assessment, and correction. These components are further described as follows:

1. Prevention of defects in the data quality through planning and design, documented instructions and procedures, and careful selection and training of skilled, qualified personnel.

2. Quality assessment through a program of regular audits and surveillances to supplement continual informal review.

3. Permanent correction of conditions adverse to quality objectives through a close-looped corrective action system.

6.1 FIELD ~~AND LABORATORY~~ QUALITY CONTROL SAMPLES

Field QC samples will be taken to evaluate the possibility that some controllable practice, such as decontamination, or sampling technique may be responsible for introducing bias in project analytical results. Three types of QC samples will be collected for chemical samples: sampling equipment rinsates, field blanks, and duplicate samples (Section 4.1, SCQ).

6.2 ACCURACY, PRECISION, AND SENSITIVITY

For the purposes of this ~~Sampling and Analysis Plan~~ PSP, ~~A~~accuracy, ~~P~~precision, and ~~S~~sensitivity are defined in the following manner:

Accuracy and Precision

Accuracy is defined as degree of conformity to the true value, and is achieved by using recognized calibration standards. Precision is defined as degree to which measurements of replicates agree to one another, being free from bias or drift in the measurement data. A measure of precision is obtained by conducting duplicate analyses and then by assessing the agreement of the measured values.

Accurate and precise data will be achieved through the use of sampling and analysis procedures that minimize biases, through the use of standard procedures, through the meticulous calibration of field and analytical equipment, and by implementing corrective action whenever measured accuracy and precision exceed pre-established limits.

Sensitivity

Sensitivity is defined as the capability of indicating minute differences. The sensitivity of field measurements (eg., penetrometer measurements) will be estimated.

Refer to Section 4.2 of the SCQ for additional detail.

6.3 COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

For the purposes of this ~~Sampling and Analysis Plan~~ PSP, Completeness, Representativeness, and Comparability are defined in the following manner:

Completeness

A sufficient number of successful ~~(valid)~~ measurements, at least 90 percent, must be obtained to ~~determine~~ characterize the extent and ~~the~~ nature of soil, subsoil, perched water and groundwater within the proposed ~~pre-design investigation area~~ waste disposal facility site.

Representativeness

Representativeness is the extent to which reported analytical results factually depict the chemistry of the sampled environmental media. This will be assured by following the SCQ, Appendix K. It is optimized through proper selection of investigation locations, sampling sites and intervals, proper sample handling, and analysis.

Comparability

Comparability is the extent to which comparisons among separate measurements will yield valid conclusions. Comparability among measurements in the remedial investigation will be achieved through the use of rigorous standard field installation, sampling, document control, data reporting, and analytical procedures.

Refer to Section 4.3 of the SCQ for additional detail.

6.4 TRAINING, RECORDS ADMINISTRATION, AND DOCUMENT CONTROL

All FEMP employees and subcontractors assigned to this project will be required to participate in a series of regularly scheduled training sessions which are designed to enhance employee awareness of each one's responsibilities and duties in the project. Field staff will receive comprehensive project and task specific training. Project daily "Tailgate Safety Meetings" will augment health and safety and project objectives training prior to the project start.

Refer to Section 4.4 of the SCQ for additional details.

6.5 PERFORMANCE AND SYSTEM AUDITS

To verify compliance with the SCQ and project-specific requirements, the FEMP project manager and designated ~~FEMP~~ Environmental QA organization shall be responsible for scheduling and conducting QA audits and surveillance. Audit results of activities covered by the SCQ are available to the EPA upon request to DOE/FN. EPA may conduct external audits of FEMP activities covered by the 1991 Amended Consent Agreement as required.

As a minimum, audits shall consist of evaluation of the QA program and procedures, effectiveness of the implementation, and review of associated project documentation. Audits shall cover applicable laboratory activities, field operations and documentation, and final reports. Auditing shall be performed in accordance with DOE guidelines, the SCQ and applicable PSPs.

Planned QA oversight of Parsons and Geotech subcontractor analysis will be conducted by Environmental QA.

As a minimum, surveillance shall consist of monitoring/observing ongoing project activity and work areas to verify item and activity conformance to specified requirements. Surveillance shall be scheduled, planned, and documented.

Refer to Section 12 of the SCQ for additional details.

7.0 FIELD ACTIVITY GUIDELINES

7.1 FIELD ACTIVITY REQUIREMENTS

This section presents a generalized description of the field activities proposed to complete Phase I and II of the Pre-~~D~~design Investigation. Field activities will consist of non-intrusive geotechnical surveying using a cone penetrometer, and intrusive sampling of soil, subsurface soil, and groundwater media using a~~s~~ soil auger. These will be accomplished in a phased approach; Phase I will consist of cone penetrometer testing, while Phase II will include installation of soil borings and monitoring wells, and the collection of soil and groundwater samples.

Procedures to be used during the performance of the field operations are derived from several FEMP program plans, procedures, ASTM guidance, and EPA sources. FEMP program plans, specifically the SCQ~~, Site-Wide RI/FS Work Plan,~~ and FEMP SC/DM Department Standard Operating Procedures will be used as guidance documents. U.S. EPA procedure reference sources include the "Compendium of Superfund Field Operations Methods" and "Hazardous Waste Site Disposal Operations." Guidance for field activities is presented in Section 7.2 below.

For those field activities for which adequate procedures do not exist, activity-specific procedures are presented. These procedures will be in accordance with commonly accepted investigative techniques and recognized industry practices.

Because there is a possibility that the FEMP and surrounding area may contain archaeological sites, which are protected under Federal law, procedures have been developed to properly protect these sites. If any material is encountered during this investigation which may be a cultural or archaeological resource, work will stop immediately and the appropriate people notified. Attachment II outlines this procedure in greater detail.

7.2 FIELD OPERATIONS PROCEDURES

Tables 7-1 through 7-5 provide references for administrative, field, and sample handling/laboratory procedures for various activities in the Operable Unit 2 field investigation. These activities are:

- Geological survey using a cone penetrometer
- Soil sampling for geotechnical soil properties
- Soil sampling for selected chemical/radiological analysis
- Groundwater sampling for selected chemical/radiological analysis
- Lysimeter installation
- Well installation
- Water level measurements

TABLE 7-1

REFERENCE GUIDELINES

Administrative Procedures	Reference Documents
QA/QC	SCQ Sections 4, 5, 10, and 11; Appendix A/Table 2-2; Appendix D; Appendix J
QA/QC of Grout	ASTM C109-92 "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars"
Chain of Custody	SCQ Volume I, Section 7.1; RI/FS Fernald Project Policy and Procedures Manual, FPP-401, Section 5.1.12
Corrective Action	SCQ Volume I, Section 15.2; RI/FS Fernald Project Policy and Procedures Manual, FPP-210
Daily Logs	SCQ Appendix J, Subsection J.4.1
Variances	SCQ Volume I, Section 15.4.1; RI/FS Fernald Project Policy and Procedures Manual, FPP-203
Document Change Request	SCQ Volume I, Section 4.4.3.2; RI/FS Fernald Project Policy and Procedures Manual, FPP-200

Field Procedures	Reference Documents
General Drilling Practices	SCQ Section 5.2.1; Appendix J, Subsection J.4.2
Monitoring Well/Piezometer Design, Installation, and Abandonment	SCQ, Section 5.2.2; Appendix J, Subsection J.4.3; PCN-EM-GW-004-1-01 and -02 - Standard Operating Procedure for Well Plugging and Abandonment
Abandonment	ASTM D5299-42 "Standard Guide for Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devices, Boreholes and Other Devices for Environmental Activities" OAC 3745-9-10 "Abandonment of Test Holes and Wells" ASTM C150-92 "Standard Specification for Portland Cement"
Well Development	SCQ Appendix J, Subsection J.4.4
Field Screening of Samples for Radioactive Contamination	SCQ Appendix K, Subsection K.5.3.2; RI/FS Fernald Project Policy and Procedures Manual, FPP-600
Decontamination	SCQ Appendix K, Subsection K.11

Sample Handling/ Laboratory Procedures	Reference Documents
Classification, Transportation, and Shipment of FEMP RI/FS Samples	RI/FS Fernald Project Policy and Procedures Manual, FPP-601; SCQ Appendix K, Subsection K.10; Volume I, Subsection 6.7; Compendium of Superfund Field Operations Methods, Section 6.0

TABLE 7-2

GROUNDWATER SAMPLING PROCEDURES AND REFERENCE DOCUMENTS

Administrative Procedures	Reference Documents
See Table 7-1	See Table 7-1

Field Procedures	Reference Documents
General Groundwater Purging and Sampling Techniques	SCQ Volume I, Subsection 6.2; Appendix K, Subsection K4.2; SC-GWM-FO-201 Groundwater Sampling Activities
Water Level Measurements	SCQ Volume I, Section 6.2.2.1; Appendix K, Subsection K.4.2.1; EP-GWM-~~200~~-FO-201 Groundwater Elevation Measurements
Field Analytical Methods	SCQ Volume I, Subsection 6.2; Appendix K, Subsection K.4.1
Parameter-Specific Sampling Procedures	SCQ Volume I, Subsection 6.2.2.3; Appendix K, Subsection K.4.2.3;
Decontamination	SCQ Appendix K, Subsection K.11 SC-GWM-FO-201 Groundwater ~~Elevation Measurements~~ Sampling Activities

Sample Handling/Laboratory Procedures	Reference Documents
Classification, Transportation, and Shipment of FEMP RI/FS Samples	See Table 7-1

TABLE 7-3

UNSATURATED ZONE SURVEY PROCEDURES AND REFERENCE DOCUMENTS

Administrative Procedures	Reference Documents
See Table 7-1	See Table 7-1

Field Procedures	Reference Documents
Lysimeter installation and sampling	ASTM D4696; Section 8.3.~~14~~ Lysimeter testing of this ~~Sampling and Analysis Plan~~ PSP
Decontamination	Appendix 3, EM-6W-004 of this ~~Sampling and Analysis Plan~~ PSP

Sample Handling/Laboratory Procedures	Reference Documents
Sample Handling and Analysis	Sections 8.5 and 8.8 of this ~~Sampling and Analysis Plan~~ PSP Analabs, A Unit of Foxboro Analytical, "Operating and Service Manual for Century Systems, Portable Organic Vapor Analyzer (OVA) Model OVA-128 and Optional Accessories, Revision C"

TABLE 7-4

GEOTECHNICAL SURVEYING PROCEDURES

Administrative Procedures	Reference Documents
See Table 7-1	See Table 7-1

Field Procedures	Reference Documents
Penetrometer Techniques	Section 8.3.1 of this ~~Sampling and Analysis Plan~~ PSP; ASTM D 3441-86 "Standard Method for Deep, Quasi-Static, Cone and Friction-cone Penetrometer"

TABLE 7-5

SOIL SAMPLING PROCEDURES

Administrative Procedures	Reference Documents
See Table 7-1	See Table 7-1

Field Procedures	Reference Documents
General Drilling Practices	See Table 7-1
Subsurface Sampling	SCQ Appendix K, Section K.5.3
Surface Sampling	SCQ Appendix K, Section K.5.1
Field Screening of Samples for Radioactive Contamination	SCQ Appendix K, Section K.11; RI/FS Fernald Project Policy and Procedures Manual, FPP-600
Decontamination	See Table 7-1

Sample Handling/Laboratory Procedures	Reference Documents
Classification, Transportation, and Shipment of FEMP RI/FS Samples	See Table 7-1
Geotechnical Analyses	ASTM reference methods as shown on Table 8-5

8.0 FIELD SAMPLING PLAN

No. 22 8.1 SAMPLE TYPE LOCATION AND ANALYSES

Table 8-1 and Figure 8-1 is a summary of soil sample collection proposed for the pre-design activity. Table 8-2 presents totals for the chemical analysis for soil and water, and Table 8-3 summarize water level measurements for inverse modeling.

Sample collection methods and field and analytical methods and procedures are discussed in the following sections.

8.2 FIELD PROGRAMS

8.2.1 Cone Penetrometer Testing

8.2.1.1 Objectives

Cone penetrometer testing (CPT) is proposed ~~as a relatively non-intrusive soil sampling method since soil is not collected for testing. CPT will~~ to assist in identifying the most suitable geology and hydrogeology. This will include identifying the thickest gray clay and identifying the location and extent of interbedded granular material.

No. 5 ~~Proposed~~ Forty-nine CPT locations are shown on Figure 8-1. The CPT activity ~~will~~ preceded other activities proposed for the Pre~~-D~~design Investigation. The locations for the CPT were selected by 3-dimensional model of uncertainties and will compliment existing data in the following areas:

- Where existing lithological sampling was sparse, but the existing data were relatively homogenous with respect to the detection of clay or sand materials, and
- Where existing data were sparse, but the data were inconclusive concerning clay or sand. These areas are possibly geologically heterogenous and were selected for additional characterizations.

These areas were selected ~~since the addition of~~ because even limited data would increase the certainty in geological interpretation.

TABLE 8-1

SUMMARY SHEET OF SOIL SAMPLES

Location	Moisture Content (ASTM 2216)	Grain Size/Hydrometer and Specific Gravity (ASTM 422, 854)	Atterburg Limits (ASTM 4318)	Unit Weight (ASTM 2937)	Standard Proctor (ASTM 698)	One-Dimensional Consolidation Tests (ASTM 4767, ASTM 2435)	Remolded and Vertical Permeability (ASTM 5084)	K_d, Total U and Iso. U	Triaxial Shear	TCLP Total U & TCLP Isotopic U	Total U & Isotopic U
Geotech											
11468	6	6	6	6	2		1,2		1		2D
11469	7	7	7	7	2	1	1,2		1		2
11470	7	7	7	7	2	1	1,2		2		2
11471	6	6	6	6	2	1	1,2		1		2
11472	6	6	6	6	2	1	1,2		1		2
11473	6	6	6	6	2		1,2		2		2
11474	7	7	7	7	2	1	1,2		1		2
11475	6	6	6	6	2	1	1,2		1		2
11476	6	6	6	6	2	1	1,2		2		2
11477	7	7	7	7	2	1	1,2		1		2D
11478	7	7	7	7	2		1,2		1		2
11479	6	6	6	6	2		1,2		2		2
11480	7	7	7	7	2		1,2		1		2
11481	7	7	7	7	2		1,2		1		2
Lysimeters											
11482										1	1
11483										1	1
11484										1D	1
11485										1	1
11486										1	1
11487										1	1D
11488										1	1
11489										1	1
11490										1	1
Wells											
11491								2		2	1
11492										1	1
11493								2		3	1
11494										1D	1
11495										1	1

TABLE 8-1

SUMMARY SHEET OF SOIL SAMPLES

Location	Moisture Content (ASTM 2216)	Grain Size/Hydrometer and Specific Gravity (ASTM 422, 854	Atterburg Limits (ASTM 4318)	Unit Weight (ASTM 2937)	Standard Proctor (ASTM 698)	One-Dimensional Consolidation Tests (ASTM 4767, ASTM 2435)	Remolded and Vertical Permeability (ASTM 5084)	K_d, Total U and Iso. U	Triaxial Shear	TCLP Total U & TCLP Isotopic U	Total U & Isotopic U
11496								2		3	1
11497	1									1	1D
11498	1							2		3	1
11499	1									1	1
11500	1							2		3	1
11501	1									1	1
11502	1							2		3	1
11503	1									1	1
11504	1							2		3D	1
11505	1									1	1

D Duplicated sample

Comments #6, 7, 8, & 17

000058

TABLE 8-2

CHEMICAL ANALYSES FOR SOIL AND WATER SAMPLES

	Analytes and Number of Samples									
Location Type	Chloride	Magnesium	Bromide	Carbonate and Alkalinity	Nitrate/Nitrite	Phosphate	Sulfate	Isotopic U & Total Uranium	TCLP Uranium & Isotopic U	Tritium
9 Lysimeters (Water)	36	36	36	9	9	9	9	10		3
" (Soil)								10	10	
3 Existing Lysimeters (Water)	3	3		3	3	3	3	3		3
15 Wells (Water)	15	15	15	15	15	15	15	16		16
" (Soil)								16	16	
Soil Sample Locations (Soil)								16	16	
K_d Water Samples								40		
K_d Soil Samples								28		
Total	51	51	51	24	24	24	24	92	42	19

Note: Numbers include duplicates where necessary

TABLE 8-3

WATER LEVEL MEASUREMENTS

Location	~~Type~~ Manual	Transducer	Frequency
1110		X	once/hour
1112	X	X	once/hour
1151	X	X	once/hour
1278		X	once/hour
11230		X	once/hour
1418		X	once/hour
1274	X		once/week
1444	X		once/week
1733	X		once/week
1843	X		once/week
1866	X		once/week
1905	X		once/week
11067	X		once/week
1064	X		once/week
1152	X	X	once/week
1160	X		once/week
1149[1]	X		once/week
1167[1]	X		once/week
1124[1]	X		once/week
1887[1]	X		once/week
1301[1]	X		once/week
1293[1]	X	X	once/week
1274		X	once/hour
1340	X		once/week
1299	X		once/week
1276	X		once/week
11074	X		once/week
11075	X		once/week

[1]Additional wells being considered for manual water elevation readings.

Comment No. 10

8.2.2 Groundwater Elevations for Inverse Modeling

An inverse model is proposed that will use measured rainfall data and the response in selected wells to estimate the hydraulic conductivity of the till. This is called inverse modeling because traditional modeling uses measured values of hydraulic conductivity to predict water level changes. The inverse model solution for hydraulic conductivity will not be a unique one, however, since the infiltration and transmissivities in the till will both be estimated parameters. The value of the model will be in its capacity to test reasonable assumptions concerning the physical structure of the geology and to act as an additional model to assess the hydrogeological properties of the study area. A description of the inverse model which will be used is:

> MODINV - Using a starting estimate of the hydraulic conductivity, the model adjusts the estimate and adds missing parameter data based upon the measured change in groundwater elevations. The model can provide a quantitative estimate of parameter value uncertainty that can indicate the value for additional hydraulic testing.

To complete the proposed inverse modeling, groundwater elevation data will be required from numerous wells within the study area for a relatively long period of time. The following wells that have possible rapid responses to precipitation recharge will be monitored with transducers and data

No 9 loggers: ~~1272, 1151, 1281, 1324, 1110, 1418, and 1112~~ 1110, 1112, 1151, 1278, 11230, 1152 1293, 1274, and 1418. Data loggers will be set to collect water levels every hour for at least one month period. Other wells will be monitored on a regular basis by hand measurement methods. One measurement per week will be made, with an additional measurement made one day after rainfall events that exceed

No. 10 0.5 inches. These wells include the following: ~~1124, 1444, 1733, 11067, 1905, 1866 and 1843~~ 1274, 1144, 1733, 1843, 1866, 1905, 11067, 1064, 1152, 1160, 1149, 1167, 1124, 1887, 1301, and 1293, 1340, 1299, 1276, 11074, and 11075.

The range in water level changes is expected to be on the order of five feet or less during the study period, which will start October 3, 1994. A 10 to 20 PSI transducer with a Hermit-brand data logger (or equivalent) will be used. Manual water level measurements will be collected on the same day, if possible, and recorded to the nearest 0.01 foot depth. The water level measurements will be compare to precipitation data to determine the possible infiltration rate using HELP modeling.

8.2.3 Sampling From Soil Boring Locations

8.2.3.1 Objectives

~~There are~~ ~~F~~fourteen boring locations (See figure 8-1) are proposed to collect soil samples to (1) characterize the engineering properties (geotechnical properties) of the soil, (2) verify existing vertical No. 12 and horizontal uranium contamination, (~~3~~4) seven of these locations are proposed to determine the solubility of uranium, (4~~3~~) assist in identifying interbedded granular material, and ~~to~~ (5) seven locations to determine the uranium retardation potential or the partitioning coefficient (K_d) for the soil in the study area.

8.2.3.2 Soil Sample Collection (Geotechnical)

No. 15 Soil samples will be collected from 14 soil borings (Geotechnical), drilled by truck-mounted hollow-stem auger drill rig and split-spoon or Shelby tube type sampler, or by Rotosonic Drilling with Shelby tube samples collected with the same hydraulic push method used for auger rigs. The proposed locations and quantity of samples are provided in Table 8-1. The analytical methods to be used are referenced No. 14 in the tables and described in Table 8-4. The sample types and depths are presented in Table 8-5, and sample volumes, containers, and preservatives are listed in Tables 8-6 ~~and 8-7~~. The final locations will be selected from the 3D model generated using the data from the Site-Wide Environmental Database and new CPT data.

The 14 proposed locations ~~will be~~ were defined upon completi~~o~~ng ~~of~~ the cone penetrometer testing. Geotechnical samples will be collected from both the brown and the gray soils as described in Table 8-5. These samples will help determine whether the soils in the study area display the preliminary engineering properties for facility design. In addition to geotechnical samples, soil samples will be No. 13 collected from ~~each~~ seven of the geotechnical borings, one from the brown clay and one from the gray clay, for a total of ~~28~~ 14 samples, and analyzed for total uranium, and isotopic uranium. ~~, TCLP Total Uranium and TCLP Isotopic Uranium.~~ These data will be used to define the vertical and horizontal distribution of uranium in the soil of the study area. ~~and the solubility of uranium.~~ ~~The TCLP samples will be collected as close to the Kd soil collection interval as practicable.~~

Samples for definition of the distribution coefficient (K_d) analysis will be collected from seven of the borings: one from the gray and one from the brown clay for a total of 14 samples (see Table 8-5).

Soil samples will be transferred to containers as quickly as possible with as little disturbance as possible. A minimum of 2000 grams (field weight) of soil will be collected from each location.

Thin walled Shelby tube samples will be shipped upright in 55 gallon drums. The sample tubes will be packed with vermiculite or similar packing material. All applicable shipping requirements including chain of custody will be followed.

TABLE 8-4

SUMMARY OF ASTM PROCEDURES

TEST NO.	TITLE
ASTM D422	Standard Method for Particle Size Analysis for Soils
ASTM D854	Standard Test Method for Specific Gravity of Soils
ASTM D2216	Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
ASTM D4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4767	Test Method for Consolidated-Undrained Triaxial Compressive Test on Cohesive Soils
ASTM D5084	Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D2435	Test Method for One-Dimensional Consolidation Properties of Soil
ASTM D698	Laboratory Compaction Characteristics of Soil Using Standard Effort
ASTM D2937	Unit Weight
ASTM D4319	Standard Test Method for Distribution Ratios by the Short-Term Batch Method
ASTM C109	Compressive Strength of Hydraulic Cement Mortars
ASTM C150	Standard Specification for Portland Cement
~~ASTM D4319~~	~~Distribution Ratios by the Short Term Batch Method~~
ASTM D420	Standard Guide for Investigating and Sampling Soil and Rock
ASTM D1452	Standard Practice for Soil Investigation and Sampling by Auger Borings
ASTM D1586	Standard Test Method for Penetrometer Test and Split-Barrel Sampling of Soils
ASTM D1587	Standard Practice for Thin-Walled Tube Sampling of Soils
ASTM D2166	Standard Test Method for Unconfined Compressive Strength of Cohesive Soil
ASTM D2487	Standard Classification of Soils for Engineering Purposes
ASTM D2488	Standard Practice for Description and Identification of Soils
ASTM D3441	Standard Test Method for Deep, Quasi-Static, Cone and Friction Penetration Tests of Soil
ASTM D4696	Standard Guide for Pore-Liquid Sampling from the Vadose Zone
ASTM D4700	Soil Sampling from the Vadose Zone
ASTM D5299	Standard Guide for Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities

Comment No. 14

TABLE 8-5 Soil Sample Types, Locations and Depths

Location	Sample ID	FACTS Sample Id	Approximate Depth (Ft.)	Moisture Content	Grain Size/Hydrometer and Specific Gravity	Atterburg Limits	Standard Proctor[3]	Consolidation Tests	Remolded Permeability	K_d Total U & Isotopic U,	Unit Weight	Vertical Permeability	Triaxial Shear	TCLP Total U & TCLP Isotopic U	Total U & Isotopic U
Geotech															
11468															
Brown			0	X	X	X					X				
			5	X	X	X	X		X		X	X			X
			10	X	X	X	X				X				
Grey			16	X	X	X					X	X	X		
			21	X	X	X					X				X
			26	X	X	X					X				
11469															
Brown			0	X	X	X					X				
			5	X	X	X	X		X		X	X			
			10	X	X	X	X				X				
Grey			16	X	X	X		X			X	X	X		
			21	X	X	X					X				
			25	X	X	X					X				
			30	X	X	X					X				
11470															
Brown			0	X	X	X					X				
			5	X	X	X	X		X		X	X			X
			10	X	X	X	X				X				
Grey			16	X	X	X		X			X	X	X		
			21	X	X	X					X				X
			26	X	X	X					X				
			30	X	X	X					X				

TABLE 8-5 Soil Sample Types, Locations and Depths

Location	Sample ID	FACTS Sample ID	Approximate Depth (Ft.)	Moisture Content	Grain Size/Hydrometer and Specific Gravity	Atterburg Limits	Standard Proctor	Consolidation Tests	Remolded Permeability	K_d Total U & Isotopic U,	Unit Weight	Vertical Permeability	Triaxial Shear	TCLP Total U & TCLP Isotopic U	Total U & Isotopic U
11471															
Brown			0	X	X	X					X				
			5	X	X	X	X		X		X	X			
			10	X	X	X	X				X				
Grey			17	X	X	X		X			X	X	X		
			22	X	X	X					X				
			27	X	X	X					X				
11472															
Brown			0	X	X	X					X				
			5	X	X	X	X		X		X	X			X
Grey			11	X	X	X	X	X			X				
			15	X	X	X					X	X	X		X
			20	X	X	X					X				
			25	X	X	X					X				
11473															
Brown			0	X	X	X					X				
			5	X	X	X	X		X		X	X			
Grey			10	X	X	X	X				X				
			15	X	X	X					X	X	X		
			20	X	X	X					X				
			25	X	X	X					X				

TABLE 8-5 Soil Sample Types, Locations and Depths

Location	Sample ID	FACTS Sample ID	Approximate Depth (Ft.)	Moisture Content	Grain Size/Hydrometer and Specific Gravity	Atterburg Limits	Standard Proctor	Consolidation Tests	Remolded Permeability	K_d Total U & Isotopic U,	Unit Weight	Vertical Permeability	Triaxial Shear	TCLP Total U & TCLP Isotopic U	Total U & Isotopic U
11474															
Brown			0	X	X	X					X				
			5	X	X	X	X		X		X	X			X
Grey			10	X	X	X	X				X				
			15	X	X	X		X			X	X	X		X
			20	X	X	X					X				
			25	X	X	X					X				
			30	X	X	X					X				
11475															
Brown			0	X	X	X					X				
			5	X	X	X	X		X		X	X			
Grey			10	X	X	X					X				
			15	X	X	X	X	X			X	X	X		
			20	X	X	X					X				
			25	X	X	X					X				
11476															
Brown			0	X	X	X					X				
			5	X	X	X	X		X		X	X			X
Grey			10	X	X	X		X			X				
			15	X	X	X	X				X	X	X		X
			20	X	X	X					X				
			25	X	X	X					X				

TABLE 8-5 Soil Sample Types, Locations and Depths

Location	Sample ID	FACTS Sample ID	Approximate Depth (Ft.)	Moisture Content	Grain Size/Hydrometer and Specific Gravity	Atterburg Limits	Standard Proctor	Consolidation Tests	Remolded Permeability	K_d Total U & Isotopic U,	Unit Weight	Vertical Permeability	Triaxial Shear	TCLP Total U & TCLP Isotopic U	Total U & Isotopic U
11477															
Brown			0	X	X	X					X				
			5	X	X	X	X		X		X	X			
			10	X	X	X					X				
Grey			15	X	X	X	X	X			X	X	X		
			20	X	X	X					X				
			26	X	X	X					X				
			35	X	X	X					X				
11478															
Brown	402790		1.5-3.0	X	X	X									
Brown	402792		3.5-6.0	X	X	X			X?		X				
Brown	402796		3.5-7.5		X	X	X		X						
Brown	402793	200119301	6.0-7.5												X
Brown	402813		7.5-10.0		X	X	X								
Brown	402798		10.5-12.0	X	X	X									
Grey	402803	200119302	20.0-21.5												X
Grey	402805		21.5-23.0	X	X	X									
Grey	402807		24.5-26.0	X	X	X									
Grey	402810		30.5-32.0	X	X	X									
Grey	402812		33.5-35.0	X	X	X									
11479															
Brown			0	X	X	X					X				
			5	X	X	X	X		X		X	X			
Grey			10	X	X	X	X				X				
			20	X	X	X					X	X	X		
			25	X	X	X					X				
			30	X	X	X					X				

TABLE 8-5 Soil Sample Types, Locations and Depths

Location	Sample ID	FACTS Sample ID	Approximate Depth (Ft.)	Moisture Content	Grain Size/Hydrometer and Specific Gravity	Atterburg Limits	Standard Proctor	Consolidation Tests	Remolded Permeability	K_d Total U & Isotopic U,	Unit Weight	Vertical Permeability	Triaxial Shear	TCLP Total U & TCLP Isotopic U	Total U & Isotopic U
11480															
Brown	402768		0.5-3.0	X	X	X					X				
Brown	402769	200119305	3.0-4.5												X
Brown	402770		5.0-7.5	X	X	X					X				
Brown	402771		3.0-7.5		X	X	X		X						
Brown	402773		9.5-7.0	X	X	X					X	X			
Brown	402774		7.5-12.0		X	X	X								
Grey	402775	2001199305	12.0-13.5												X
Grey	402777		14.0-16.5	X	X	X					X	X	X		
Grey	402779		18.0-20.0	X	X	X									
Grey	402783**		22.5-24.0												
Grey	402784		24.5-27.0	X	X	X					X				
Grey	402785**		27.0-28.5												
Grey	402787		29.0-31.5	X	X	X					X				
11481															
Brown			0	X	X	X					X				
			5	X	X	X	X		X		X	X			
Grey			15	X	X	X	X				X				
			20	X	X	X					X	X	X		
			25	X	X	X					X				
			30	X	X	X					X				
			35	X	X	X					X				

000069

TABLE 8-5 Soil Sample Types, Locations and Depths

Location	Sample ID	FACTS Sample ID	Approximate Actual Depth (Ft.)	Moisture Content	Grain Size/Hydrometer and Specific Gravity	Atterberg Limits	Standard Proctor	Consolidation Tests	Remolded Permeability	K_d Total U & Isotopic U,	Unit Weight	Vertical Permeability	Triaxial Shear	TCLP Total U & TCLP Isotopic U	Total U & Isotopic U
Lysimeters															
11482			7											X	X
11483			35											X	X
11484			55											X	X
11485			7											X	X
11486			35											X	X
11487			55											X	X
11488			7											X	X
11489			35											X	X
11490			55											X	X
Wells															
11491	402633	200119330	13											X X	
	402632	200119332	13												X
	402639		13							X					
	402635	200119333	13.5											X X	
	402634	200119334	13.5												X
	402638		13.5							X					
	402637		27-29											X X	
	402636	200119331	27-29												X
11492	402641	200119336	20											X	
	402640	200119335	20												X
11493			20							X[1]				X X[2]	X
11494			20											X	X
11495			20											X	X
11496			20							X[1]				X X[2]	X
11497			20											X	X
11498			20							X[1]				X X	X
11499			20											X	X
11500	402646	200119500	10.5-11.0											X X	
	402645	200119501	10.5-11.0												X
	402644		11.0-12.0							X					
	402643		12.0-12.5							X					
	402648	200199502	12.5-13.0											X X	
	402647	200199503	12.5-13.0												X
	402650	200119524	21.0-22.0											X X	
	402649	200119499	21.0-22.0												X
11501			20											X	X
11502			20							X[1]				X X[2]	X
11503			20											X	X
11504			20							X[1]				X X[2]	X
11505			20											X	X

[1] 2 K_d samples will be collected from each boring, one from the brown clay and one from the gray clay. The actual depth will be determined in the field and representative samples will be collected as close to the brown/gray interface as practicable.

2 TCLP samples will be collected from the same interval as the K_d.

TCLP samples will be collected as close to the screened interval as possible.

3Locating the cell is dependendent on the gray clay which is at an avarage depth of 11 feet. Therefore, soils at a 10 foot depth have a potential to be used as fill; thereby, necessitating the need for the Standard Proctor Test.

Comments # 16, 18, & 19

000070

TABLE 8-6

SAMPLE VOLUME, CONTAINERS, AND PRESERVATION - SOIL SAMPLES

Parameter	Container	Preservation *
TCLP Uranium	1 x 500 mL wide mouth amber glass	4°C
Specific Gravity, Water Content, Liquid Limit, Plastic Limit, Hydrometer Analysis	1 x 500 ml glass wide mouth or (1) 3 x 24 in. Shelby tube	None
Dry Unit Weight, Consolidation, Hydraulic Conductivity (Permeability), Unconfined Compression	(1) 3 x 30 in. Shelby tube	None
Consolidated Undrained Triaxial, with pore pressure measurement	(1) 3 x ~~30~~ 36in. Shelby tube	None
Total Uranium/Isotopic Uranium	500 ml	None
K_d	2000 g (field weight)	None

* prevent freezing

Comments Nos. 15 & 19

8.2.4 Lysimeter Installation and Sampling ~~Testing~~

Installation requirements for lysimeters are detailed in ASTM D4696 and the TIMCO installation methodology (TIMCO may be replaced with another vendors specification). These documents are provided in ~~Appendices~~ Attachments ~~VIII~~X and III respectively for reference. A summary of the proposed installation requirements is provided below.

8.2.4.1 Objectives

Nested lysimeters will be installed and sampled to determine the nature of uranium and the concentration of uranium in the glacial till and the unsaturated ~~Upper~~ Great Miami Aquifer for the ~~E~~eastern ~~S~~site and for an off-site location. The data from the off-site location are intended to establish background lysimeter uranium concentrations. Also, age dating, by conducting tritium analysis, will be performed for the vadose zone. The age of the water will assist in determining the time it takes surface water to reach a certain depth in the vadose zone. Samples will be collected to determine when the lysimeters have reached equilibrium and to establish some general chemistry properties for the groundwater collected from the vadose zone.

8.2.4.2 Lysimeter Placement and Installation

Preliminary locations for the lysimeter placement are shown in Figure 8-1. These locations were selected using 3-D modeling of the data from the SED and the CPT's. Lysimeters will be placed in clusters to monitor the fluid characteristics at multiple depths at one location. The final locations for installation will be selected to obtain data that is representative of the till; consequently, these representative areas will be determined after penetrometer testing and 3-D modeling has been conducted.

There ~~will be~~ are two proposed on-site locations with three nested lysimeters each, and one off-site location with three lysimeters. The lysimeters will be installed using a hand-auger and Rotosonic drilling, the shallow~~i~~est installation being approximately 7 feet deep and located in the upper brown till, the second deepest installed approximately 5 feet from the base of the till (approximately 35 to 40 feet deep), and the deepest approximately 5 to 10 feet into the Upper Great Miami Aquifer (approximately 50 to 55 feet deep). General drilling practices will be in accordance with the SCQ. Table 8-8~~a~~ shows the approximate anticipated depth for the lysimeters. The proposed depth may be within the brown or gray clay.

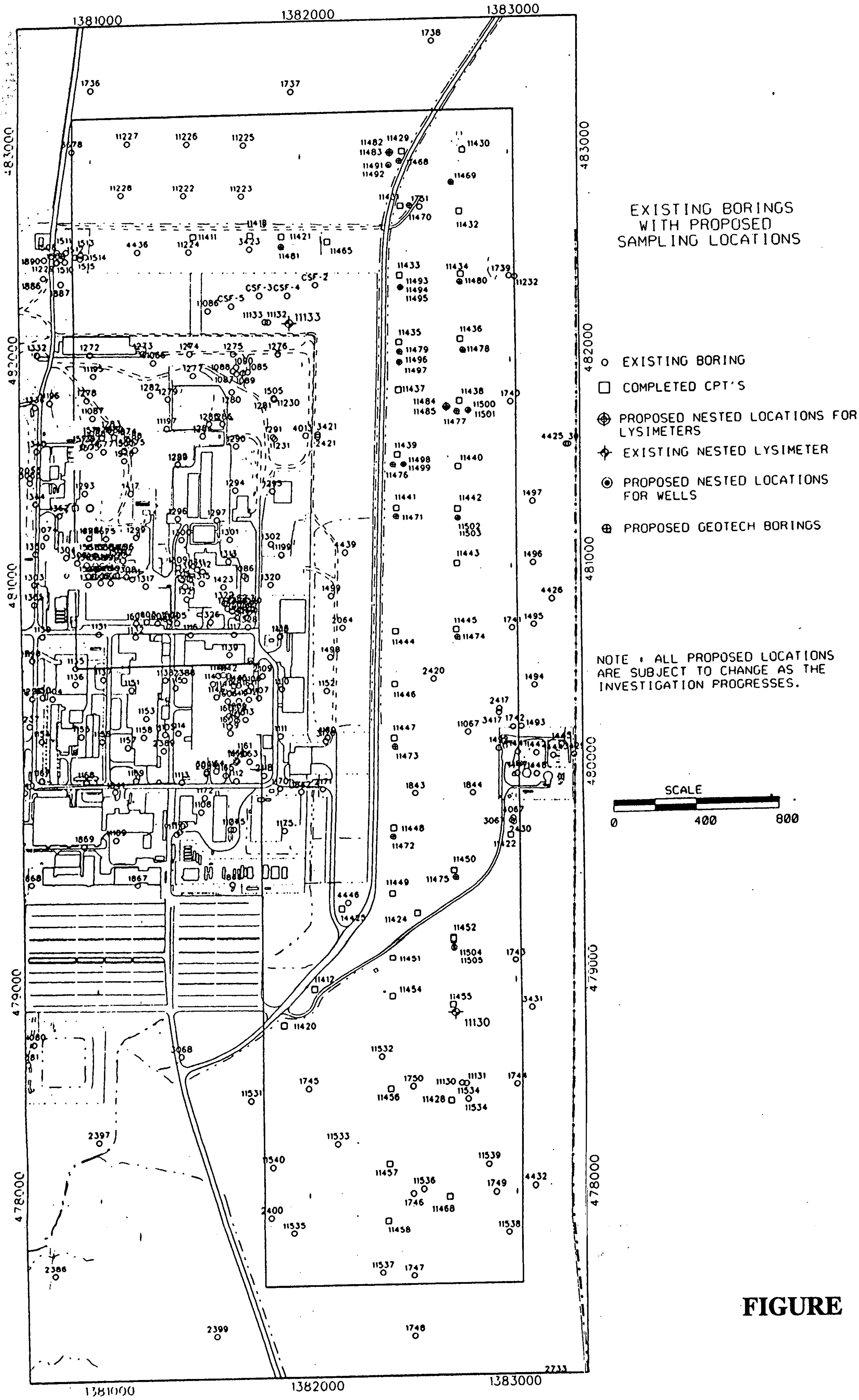


FIGURE 8-1

000073

6481

TABLE 8-8
PROPOSED LYSIMETER DEPTHS

Location	Depth (feet)*
~~Location 1~~	
11482	7
11483	35
11484	~~55~~7
~~Location 2~~	
11485	~~7~~30
11486	~~35~~37
11487	~~55~~27
~~Location 3~~	
11488	7
11489	35
11490	55

* Dependent upon geological conditions

The proposed lysimeter (TIMCO™ Deep-Sampling Cup or equivalent) is a 2-inch diameter vacuum/pressure soil pore water sampler as presented in Attachment III. The lysimeter allows water to enter a micro-porous cup at the instrument's base through capillary forces or vacuum. The cup is attached to an 18-inch PVC cylindrical body with full-depth riser and a PVC head. The head assembly attaches to the riser and connects sample and pressure ports to the lysimeter via 1/4-inch nylon tubing. The lengths of the nylon tubing extend from the lysimeter body through the riser head at the surface and are used for vacuum extraction and pressure sampling. The sample tube extends from the head through the lysimeter to a point just in contact with the inside base of the lysimeter. The vacuum extraction tube extends into the lysimeter to a point approximately 3 inches below the inside of the cap.

Prior to installation, the lysimeter and associated tubing will be decontaminated and installed according to manufacturer's specifications and SCQ procedures. After lysimeter and nylon tube decontamination, the ends of the tube will be clamped off at the surface to avoid the inadvertent introduction of foreign material into the tubing. The lysimeter components will then be assembled and installed with a full-depth, 2-inch PVC riser screwed on to the lysimeter body to house the nylon tubing. The tubing will be measured and cut to allow approximately 2 feet of stick-up at the surface. A 3- to 6-inch-thick slurry of silica flour and distilled water will be tremied into the open borehole. ~~However, p~~Prior to making the slurry mixture, the composite silica flour sample will be ~~sampled and at each location and a composite will be analyzed~~ submitted for analysis for total and isotopic uranium. The composite will consist of a sample of silica flour from each location. This will be conducted at a rate of one sample per on-site nest for a total of three samples. A~~n~~ bromide indicator ~~(such as bromide)~~ will be added to the water that is used in slurry production so that the influence of the added water on the sample can be assessed. The lysimeter and riser will be gently lowered into the boring and secured at the surface to prevent floating.

Additional slurry will be placed 2- to 4-inches above the top of the ceramic tip of the lysimeter. At that point, 80/100 mesh sand will be poured to a minimum of 3 to 6 inches above the top of the lysimeter, followed by a column of Volclay grout to within 3 feet of the surface, then a bentonite seal. This grout will be placed with a tremie line and will prohibit shallow water from draining into the lysimeter zone. The lysimeter head will then be connected to the tubing. The same volume of water that was added to the slurry for the lysimeter installation will be purged from the lysimeter. Sampling will be initiated 48 hours after purging.

8.2.4.3 <u>Lysimeter Sampling</u>

Sample recovery from the lysimeter will be in accordance with manufacturer's instructions, general SCQ protocol and ASTM D4696-92. After satisfactory installation of each lysimeter, a vacuum hand pump will be attached to the pressure port of the lysimeter and used to lift the sample into the holding No. 26 chamber of the lysimeter. Pressure should be gently increased ~~until 9 psi is achieved~~ to lift the sample into the holding chamber of the Deep-Sampling Lysimeter.

After installation and purging, ~~there will be a~~ an estimated total of four rounds of samples will be collected. ~~The first three rounds, which will be approximately five days apart, will be analyzed for bromide, calcium, and magnesium.~~ Sample collected during the first three rounds will be analyzed for bromide, chloride, and magnesium. The results of the analysis will be plotted to determine when or if the bromide concentration ~~is reading 0 ppm, which is background,~~ is approaching background, which will be determined by sampling existing lysimeters, and when or if the ~~calcium~~ chloride and magnesium concentrations equilibrate. Depending on the results, it may be determined that additional purging of the lysimeters be conducted to obtain equilibrium before collecting the final round of No. 27 samples. ~~This final round, which will be at equilibrium, will be analyzed for total uranium, isotopic uranium, bromide, calcium, magnesium, alkalinity, nitrates, and sulfates.~~ Samples collected during this final round will be analyzed for total uranium, isotopic uranium, bromide, chloride, magnesium, alkalinity, nitrate/nitrite, carbonate, phosphate, and sulfates. One tritium sample will be collected from the shallowest lysimeter from each on-site nest for a total of three.

It is anticipated that the volume of water collected from the lysimeters may be too small to conduct all of the aforementioned analyses. Therefore, samples will be collected on subsequent days with the following prioritization:

- On-Site Locations

  Total Uranium, Istopic Uranium, Tritium, Bromide, Chloride, Magnesium, Alkalinity, Nitrate/Nitrite, Carbonate, Phosphate, Sulfate

- Off-Site Locations

  Total Uranium, Isotopic Uranium, Tritium, Bromide, Chloride, Magnesium, Alkalinity, NitrateNitrite, Carbonate, Phosphate, Sulfate

Bromide will be ~~analyzed as it was~~ added to the slurry as a tracer and will assist in determining when the lysimeter has reached equilibrium. ~~Calcium~~ Chloride and magnesium ~~occur naturally and will~~ will also be analyzed to assist in determining lysimeter equilibrium. Since demineralized water will be used in the slurry for installation, the ~~calcium~~ chloride and magnesium concentrations are anticipated to rise until they equilibrate, and at this point it can be assumed that the lysimeters have reached equilibrium. Uranium analysis will be conducted so a comparison can be made with the previously installed lysimeter uranium concentrations. This will assist in determining a potential background uranium concentration for lysimeters or for the vadose zone. Tritium samples will be collected and analyzed to assist in determineing the age of the water in the vadose zone. The other analytes analyzed will be used in a comparison with the general chemistry of the perched groundwater, which will be collected in the proposed wells for this investigation.

In addition to the sample collection, field measurements for pH, ~~total suspended solids~~ turbidity, total dissolved oxygen, and temperature will be taken. These field measurements will be taken after sample collection where possible.

All samples and measurements will be collected, handled, documented, shipped, and validated according to SCQ protocol.

During the drilling of the lysimeter installation soil samples will be collected, described according to ASTM D2488, and archived. Soil samples will be collected from the interval selected for placement of the lysimeter and analyzed for total uranium, isotopic uranium, TCLP total uranium, TCLP isotopic uranium, moisture content, and grain size (see Table 8-1). The uranium analysis will assist in~~,~~ determining the vertical and horizontal extent of ~~urnaium~~ uranium contamination and the solubility of detected uranium.

All samples will be visually described~~,~~ and all sample collection points will be surveyed to define the surface elevation and the northing and easting location.

In addition to sampling the newly installed lysimeters, lysimeters 11132, ~~11133,~~ 11130, and 11131 will be samples for total uranium, isotopic uranium, ~~calcium~~ chloride, magnesium, alkalinity, nitrate/nitrite, carbonate, phosphate, and sulfate.

8.2.5 ~~New~~ Well Installation

8.2.5.1 Objectives

There are 15 wells that will be installed as part of the Pre-~~D~~design Investigation. There ~~will be~~ are five proposed nests with three wells each. The objectives of ~~these wells~~ the installation are to (1) identify interbedded and interconnected granular material in the till, (2) verify existing uranium contamination in the till, (3) identify the solubility of uranium present in the till, and (4) ~~and~~ lateral and vertical perched groundwater gradients. The locations of these wells have been selected using a 3D model which was generated from the Sitewide Environmental Database and CPT data.

8.2.5.2 Well Installation

The wells will be installed using a Rotasonic™ drill rig and according to the SCQ. Continuous samples will be collected for archive in the Rotasonic™ barrel or in advance of the auger, through the till to an approximate maximum depth of 30 feet. No boring is proposed to penetrate through the till into the regional aquifer. Wells will be completed using ~~two~~ 2-inch diameter, 316 stainless steel riser and .010-inch slotted screen 2 to 5 feet in length across the perched water interval. The screening interval will be selected by the field geologist with approval from the OU2 Task Manager. Table 8-5 shows well depths of 20 feet. These depths are estimates and subject to change. Filter pack will be well-sorted quartz sand of 20-40 mesh (medium). Wells will be developed after the grout surface seal has cured per the SCQ requirements.

The screening interval will be determined by identifying the largest interval of granular material in the Rotasonic™ core sample in the perched groundwater zone.

8.2.5.3 Chemical Sampling of Water and Soil From the New Wells

Groundwater sampling will be conducted after developing the newly drilled wells. Equipment may include but is not limited to bailers, surge blocks, pumps, and hoses. All wells will be developed and ~~to achieve turbidity free water (<5 NTU), but no less than five times the standing water in the well.~~ pParameter specific and general sample collection procedures will be conducted according to the SCQ and RI/FS QAPP. Water levels will be recorded in all proposed new and existing wells prior to sampling to establish baseline information; levels will again be measured in all new and existing wells at the close of the project. Field measurements of water temperature, pH, conductivity, ~~total suspended solids~~ turbidity, and dissolved oxygen will be taken and recorded. One round of samples will be collected and analyzed at a contract laboratory for alkalinity, bromide, ~~calcium~~ chloride, magnesium, nitrate/nitrite, phosphates, sulfate, isotopic uranium, total uranium, carbonate, and tritium.

8.2.5.4 Groundwater Level Measurements From New Wells

Groundwater level measurements from wells for each round will be collected within a 24-hour period of consistent weather conditions to minimize atmospheric and precipitation effects on groundwater levels. In addition, groundwater levels will be recorded for all new wells at the time of completion and after well development. Section K.4.2.1 of the SCQ outlines the procedure for taking water level measurements. All measurements will be recorded to the nearest 0.01 feet. All wells will be surveyed ~~according to SCQ protocol~~ and their locations added to the Site-Wwide Environmental Database.

8.2.6 Other Sampling Activities

Groundwater samples will be collected from a representative contaminated groundwater well from the Plant 2/3 area, and a representative clean (background) groundwater well closes to or in the study area. A minimum of 20 gallons of groundwater will be collected from each well. The groundwater will be placed in containers with a minimum of air in the container. This water is intended for use in the K_d study. Samples will be taken to the on-site laboratory for use in the extraction process.

8.3 FIELD METHODS

8.3.1 <u>Cone Penetrometer Testing Method</u>.

See Attachment VIII for the complete ASTM D3441-86 method. In summary, truck mounted hydraulic pushing equipment is used to push a 1.5-inch diameter steel rod into the ground. Pressures, up to 40,000 pounds, are used to push the rods while end bearing resistance and friction resistance are measured by transducers located at the tip. Rate of penetration is maintained constant at 2 to 4 feet per minute while the resistance is recorded by data logger equipment in the truck.

The ability of the CPT to define shear strength and lithological contacts will be assessed by collecting CPT data adjacent to existing borings where geotechnical data are available. Precision of the CPT will be assessed by conducting at least two pushes of the cone penetrometer side by side. The mechanical/electrical precision for the ASTM method is stated to be ± 5 to 10 percent in end bearing resistance and 10 to 20 percent in friction resistance. This range of variance is acceptable in the calculated shear strength since a safety factor of 1.5 to 2 is usually applied to these data.

The report from the penetrometer will include lithological interpretations based upon the shear strength encountered. The CPT holes will be abandoned by filling with a non-shrinking (Type K) portland cement grout (Attachment VI).

8.3.2 <u>Rotasonic™ Drilling and Sampling</u>

Rotasonic™ drilling is different from conventional drill methods~~,~~ and is ~~currently not~~ described in the SCQ. The drill energy comes from an oscillator that imparts vibrational force directly to the slowly rotating drill string. This drilling method will be used for collecting samples for geological descriptions, and for lysimeter and well installation. Also, soil samples collected from Rotasonic™ drilling will be visually described and used for chemical isotopic, and for K_d analysis.

The sample barrel is first advanced 5 to 10 feet into the soil profile. The sample barrel is then disconnected and an override casing is attached and drilled over the sampler barrel. During this process, the annular space between the casing and sampler is lubricated with water to flush any cuttings. Once the casing is overdrilled to the level of the sample barrel, the casing is disconnected and the sampler barrel pulled back. The sample is then extruded from the sample barrel into plastic sheaths and given to the geologist for lithological description and sample archiving. A decontaminated sampler is then attached and the process repeated. The liquid ~~that is~~ introduced as a lubricant does not contact the cored sample, which is in all cases collected ahead of the override casing.

As the Rotasonic™ drill tools penetrate the soil medium, the soil particles cannot vibrate in unison with the drill steel. The individual soil particles vibrate in random directions and fluidize. This greatly reduces the friction against the drill pipe and allows the soil to move aside. This only occurs within about 1/8 inch from the side of the drill steel. If the medium being penetrated is clay this condition is reversible once the sonics are shut off. This means that a casing, once sealed in a clayey medium, will be effectively sealed once the vibration stops. This phenomenon has allowed the use of multiple override casings to "seal" off upper aquifers or contaminated zones with the Rotasonic™ system. The dual casing capability will reduce the chance of cross-contaminating perched groundwater layers in this clay.

All casings are retrieved and decontaminated to Level II as specified for well casings in accordance with the SCQ. This drilling method will be used for well installation and lysimeter installation, and possibly conducting lithologic description sampling for calibration ~~cone penetrometer~~ CPT data.

8.3.3 Subsurface Soil Sampling

Soil borings not using the Rotasonic™ method (i.e., geotechnical soil samples) will be drilled using a truck-mounted hollow-stem auger drill. Soil samples will be collected by split spoon or Shelby tube type sampler. After drilling and sampling is complete, each boring will be plugged with a non-shrinking (Type K) portland cement (see Attachment VI) grout from the bottom to surface through the hollow stem auger or via a tremie pipe; after grout has cured, a minimum of a 12-inch cement plug will be placed in the hole.

Continuous samplinges will be ~~collected~~ conducted in advance of the hollow-stem auger described above, from six inches below surface to planned total depth and will be described in the field according to ASTM D24788. All samples will be field screened with beta/gamma and photoionization detectors (PID), and values recorded.

8.3.4 Waste Handling/Disposal

During the performance of this fieldwork, wastes in the form of drill cuttings~~,~~ and decontamination wastes will be generated. Drill cuttings will be field screened using a Ggeiger-Mmüller detector and ~~P.I.D.~~ PID probes to assure that the cuttings are uncontaminated. These cuttings will be placed into clean 55-gallon drums during boring operations. After the borehole has been grouted, the drummed cuttings will be emptied in the area of the boring and spread over the ground surface.

Decontamination of drilling and sampling equipment will be performed at the Drilling Contractors Decontamination Area. Fluids and any solid materials generated will be handled in accordance with the normal operation of that facility's contamination treatment/control devices. Well-sampling purge water and decontamination water will be placed in the FEMP General Sump.

8.3.5 Project Surveying

Land surveying will be performed at all cone penetrometer and drilling locations. Surveying will be performed by a State of Ohio Registered Professional Land Surveyor. All surveyed locations will be accurate to the nearest 0.01 feet elevation accuracy. Survey points will be located to within 0.5 feet accuracy and integrated into the existing FEMP Geographic Information System (GIS), and incorporated into the site data base.

8.4 GENERAL SAMPLING REQUIREMENTS

8.4.1 Field QC Samples

Field QC samples will be collected during the Operable Unit 2 Pre-~~D~~design Investigation. The QC sample types and rationale for selection follow:

- Field blank samples will be prepared for 1 in 20 samples or one for every round of groundwater samples and analyzed for the same target analytes specified for the field sample collected during the sampling event. ~~The frequency of field blanks is based on the total number of rounds of groundwater samples collected from each Operable Unit 2 subunit.~~ A field blank sample is prepared at the sampling site by the field team by pouring deionized/organic free water into the appropriate sample containers specified in Table 8-~~8~~7.

- An equipment rinsate sample will be collected for every round of water samples and every ~~5~~ 20 soil samples or as required in the SCQ Appendix A Table 2-4, following decontamination of the sampling equipment. The sample will be obtained by rinsing clean ~~soil sampling~~ split-barrel with with deionized water and collecting the rinsate for analysis.

- Duplicate water samples will be collected at a frequency of 1 per every round of groundwater sampling. These samples should be assigned a unique sample number and sent to the laboratory as a blind sample. No duplicate soil samples will be collected due to the lack of an effective field compositing technique which would produce meaningful data where discrepancies ~~could absolutely be~~ are considered a laboratory precision problem.

- Container blanks will not be ~~included in the QA samples since~~ collected because containers used for sampling activities are pre-cleaned by the manufacturer and have a certificate of analysis for each lot of containers.

8.4.2 Alternate Sampling Procedures

The implementation of alternate sampling procedures could be necessary if any unanticipated problem developed during the field investigative effort. Alternate sampling procedures, or deviations, consist of either work plan variances or work plan non-conformances.

If it becomes necessary to deviate from a sampling standard operating procedure, such a deviation will be handled in the following manner:

1. The field sampling technician or geologist will identify the need to deviate from the sampling plan or procedure.

2. The technician will bring the problem to the attention of field crew management and make recommendations about how to best proceed with sample collection with minimal impact to the existing sampling procedures and project ~~data quality objectives~~ DQOs.

3. Possible solutions and the impacts of the solutions on the project ~~data quality objectives~~ DQOs will be determined.

4. A Variance Request Form (example in Attachment IV) will be implemented which describes the nature of the variance, the need for the variance, and how variation from the PSP will minimize or have no impacts to the project ~~data quality objectives~~ DQOs.

5. QA will evaluate and approve the Variance Request. Verbal approval from QA will be received prior to implementation of the variance.

6. The approved Variance Request Form will become a part of the overall project historical file, and will be reported in the final project report.

~~Variance approvals will, in most instances, be obtained prior to the actual performance of the variance in the field. However, depending on the situation, prior variance approval may not be feasible due to practical aspects associated with the fieldwork being performed.~~

Work plan non-conformances are defined as field or laboratory activities which have been completed, but are subsequently found to not have been performed according to the Work Plan. A non-conformance may have a significant impact on the usability of field- or laboratory-derived investigation results. Resolution of a project non-conformance will be the responsibility of the b. 30 ~~Operable Unit 2 Project Manager~~ Site-Wide Disposal Facility Project Manager.

8.4.3 Sample Equipment and Materials

All environmental media samples will be collected with equipment which is functional, designed for the specific purposes of the sampling event, and properly decontaminated. Sampling will be accomplished with equipment which is constructed of nonreactive materials.

Sampling containers will be composed of materials which are commonly used for the type of media to be sampled. All sample containers will be of the volume necessary for laboratory analysis purposes. Attachment V lists equipment typically used per type of sampling activity.

8.4.4 Equipment Decontamination

All drilling and media sampling equipment will be decontaminated to Level II in accordance with Appendix K of the SCQ specifications~~, and according to procedural memos issued by the Radiation Control Department~~.

8.4.5 Sample Volume, Containers, and Preservation

Sample containers will be pre-cleaned by the manufacturer and will be accompanied by a certificate of analysis. The sample container types and preservative requirements are specified in the FEMP SCQ and are summarized in Tables 8-~~7~~6 and 8-~~8~~7 for solid and aqueous matrices, respectively. Sample volumes will be consistent with the contract laboratory requirements.

8.4.6 Sample Collection Documentation

~~Both surface and g~~Groundwater samples collected in the field are documented on the Water Sample Collection Log~~, and Water Quality Field Collection Report forms~~. An example of ~~these~~is form is shown in this report as Attachment V; however, some forms are being revised and the latest revision will be used.

The collection of soil and sub-soil materials are documented on the following forms:

- ~~Sample Collection Log~~
- ~~Visual Classification of Soils~~
- Lithologic Log
- No. 31 ~~Subsurface Soil~~ Sample Collection Log

Examples of these forms are shown in Attachment V.

In addition to these forms, daily field activities are recorded on the Field Activity Log form. This form is included in Attachment V of this report.

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TABLE 8-7

SAMPLE VOLUME, CONTAINERS, AND PRESERVATION - WATER SAMPLES

Parameter	Container	Preservation
Tritium	1 x 1 L plastic	None [1]
Alkalinity, Bromide, Carbonate, Chloride, and Sulfate	1 x 500 ml plastic and 1 x 250 ml plastic	Cool, 4°C
Alkalinity, Carbonate, Chloride, and Sulfate	1 x 500 ml plastic and 1 x 250 ml plastic	Cool, 4°C
Bromide and Chloride	1 x 500 ml plastic	Cool, 4°C
Magnesium	1 x 500 ml plastic	Nitric Acid, pH <2 Cool, 4°C
Nitrate / Nitrite and Phosphate	1 x 250 ml plastic	Sulfuric Acid, pH <2 Cool, 4°C
Total Uranium and Isotopic Uranium	1 x 1 L plastic and 1 x 4 L plastic	Nitric Acid, pH <2

[1] Do not cool

Comment No. 32

8.4.7 Sample Collection Reports

No specific sample collection field reports are proposed for this project. Rather, the information contained in the field forms specified in Section 8.4.6 of this report serve as the basis for documenting all significant aspects of the sample collection activities.

Upon completion of the project, all significant task related information, including copies of field forms and laboratory related forms, including analytical results of samples taken, are included in a Task Closure Report. This report is initiated by the SC/DM Department of the Environmental Division, and will be sent to Operable Unit 2 for their records.

8.5 SAMPLE MANAGEMENT

8.5.1 Sample Identification and Labeling

A unique six-digit sample number will be assigned to each sample collected by Environmental Monitoring. Each sample container will also be affixed with a sample label containing, at a minimum, the information specified on Form 7-2, Appendix B of the FEMP SCQ.

8.5.2 Sample Chain of Custody Records and Field Data Documentation

Sample custody procedures as outlined in the FEMP SCQ will be observed throughout the sample handling process from field collection to shipment or delivery of the samples to the laboratory. The Site-Wide Analysis Request/Custody Record (SAR/CR) form will be completed for all samples delivered to the on-site sample processing laboratory.

In addition to the custody records, a Sample Collection Log will be completed which summarizes all samples collected from a single borehole or well. A Groundwater Quality Report will be prepared for each well sampling event to document the well purge data and groundwater conditions prior to sample collection. A Visual Classification of Soils Form and Well Installation Diagram will be completed for soil borings and well installations when appropriate. Furthermore, all field investigation work is documented in detail on a daily basis using the Field Activity Daily Log Form.

8.6 FIELD EQUIPMENT METHODS

8.6.1 Calibration of Field Equipment

Field equipment to be used during this investigation is divided into the categories of health and safety monitoring~~,~~ and field screening and monitoring. At a minimum, all equipment will be operated and calibrated ~~once per week, or once per day, depending on the~~ according to the equipment manufacturer's specifications. All instruments are calibrated to manufacturers' specifications. Written logs of equipment calibration are maintained by the appropriate personnel in charge of performing the instrument calibrations.

~~Health and Safety monitoring equipment consists of the following instruments:~~

~~**HNu PI-101 Photoionization Detector** - equipped with a 10.2 EV lamp. This instrument is calibrated daily using isobutylene gas as a standard. During use, in order to spot check the instrument for proper operation, a hydrocarbon based felt tipped pen is commonly used. However, this practice is not a substitute for routine instrument operation checks.~~

~~**Ludlum Model 12 Alpha Meter** - equipped with a pancake probe. The instrument is calibrated against a background concentration. If the background concentration exceeds 2 counts per minute (cpm), then the instrument is not used. The instrument is calibrated to a known standard once per week.~~

~~**Ludlum Model 2 BetaGamma Meter** - This instrument is calibrated once per week against a background standard. If, during routine use, the operator notes that the background concentration exceeds 300 cpm, then the instrument is not to be used.~~

~~**Ludlum Model 19 Micro-R-Meter** - This meter is calibrated to a known standard once per week.~~

~~**Ludlum Model 9 Ion Chamber** - This instrument is calibrated to a known standard once per week.~~

~~Field Screening and Monitoring equipment consists of the following instruments:~~

~~**HNu PI 101 Photoionization Detector** - equipped with a 10.2 EV lamp. This instrument is calibrated daily using isobutylene gas as a standard. During use, in order to spot check the instrument for proper operation, a hydrocarbon based felt tipped pen is commonly used. However, this practice is not a substitute for routine instrument operation checks.~~

~~**Orion Model 250A pH Meter** - This instrument is calibrated daily, and is compared to known calibration standards at least twice prior to each reading. The buffer solutions typically used for calibration are pH 4 and pH 7 Standard Units.~~

~~**YSI Model 33 S.C.T. Conductivity Meter** - The conductivity meter is calibrated daily to a known standard.~~

~~**Solonist Water Level Indicator** - There is no known standard to which a water level meter is calibrated. The meter is, more than calibrated, maintained by ensuring that it is in proper operation, and that the batteries are charged.~~

~~**Hach Turbidity Meter** - This instrument is calibrated to a known standard on a daily basis.~~

~~**YSI Model 51 B Dissolved Oxygen Meter** - This instrument is calibrated to a known standard on a daily basis.~~

~~**ESP-1, Model 141, SPA-3 Sodium Iodine Scintillation Detector** - This instrument is use for radiation surveying and will be calibrated to a known standard on a daily basis.~~

8.6.2 Documentation of Calibration

Separate logbooks are kept for each type of instrumentation. The logbooks contain a history not only of the instrument calibration but also of any unusual or irregular problems noted during the use of that particular instrument. Four separate documents are used to record calibration of instruments. Attachment V contains examples of the calibration documentation.

000089

The forms are labeled as follows:

- Water Quality Field Collection Report
- Weekly Calibration Log
- Use, Calibration, and Maintenance of the HNu PI 101
- Instrument Baseline Data Sheet

8.7 ANALYTES OF INTEREST

The analytes of interest have been developed on "time of travel" needs and what would be considered the best tracer analytes. The analytes of interest are total uranium, isotopic uranium, TCLP uranium, No. 32 chloride, bromide, ~~fluoride~~, tritium, nitrate, sulfate, carbonate, magnesium, and phosphate~~, and colloids~~.

8.8 LABORATORY METHODS

8.8.1 Analytical Methods

The contract laboratory will adhere to the requirements of the SCQ ~~which is currently under revision. EPA CLP or~~ and SW-846 requirements will be followed for inorganic analyses. Analytical methods for radioisotopes and K_d will follow performance based criteria cited directly by the SCQ and the procedures described in section 8.8.2. In all cases, the laboratory shall generate a CLP data package, or equivalent for non-CLP analytes such as general wet chemistry. The CLP data package will be ~~validatable~~ validated to ASL D.

8.8.2 K_d Analysis

The K_d Study is being performed to determine how natural species of uranium in groundwater and soil partition between phases. To obtain the most representative results, natural materials will be used whenever possible. This includes natural soils from the location of concern, natural groundwater contaminated with uranium, and natural groundwater without contamination.

No. 34 Fourteen standard adsorption tests and desorption tests, following ASTM Method D-4319-83, will be performed on soil samples and contaminated groundwater. The fourteen soil samples will be collected from seven borings. Seven soil samples will be collected in the brown clay and seven in the grey clay. Fourteen soil samples will be collected, one from each soil location, and sent off site for total and isotopic uranium analysis. Contaminated groundwater will be collected from Plant 2/3 perched groundwater area, and clean groundwater will be collected from the pre-design study area wells and a sample of each will be sent off site for total and isotopic uranium analysis.

The disposal facility will be constructed over clean till, so the partitioning of uranium will occur first from potentially contaminated leachate seeping through the bottom of the facility liner. The contaminated groundwater is intended to represent the leachate as it leaves the disposal facility.
No. 35 ~~Speciation studies have shown that despite the original nature of the waste or source material, uranium, therefore, speciates into two predominant forms in groundwater, carbonate, and phosphate.~~

After the adsorption tests are completed, the soil from the adsorption tests will be placed into a new reactor with clean groundwater to assess its desorption characteristics. This test will represent conditions where contaminated leachate moves through the till allowing the soil to adsorb a fraction of the uranium, then cleaner leachate moves through, creating an environment where uranium can desorb from the soil back into the groundwater.

A number of factors affect the K_d in natural conditions; groundwater-to-soil ratio, the sorption isotherm, pH, dissolved oxygen, temperature, permeability of the same soil, and others. During the tests pH and temperature factors can be controlled by keeping them constant near the in situ levels.
No. 33 Other factors will be tested to determine their impact on the K_d results. The calibration tests will be performed on the grey clay samples since it is assumed that most of the brown clay will be removed before construction of the disposal facility. With the calibration tests, the grey clay will be tested 15 times, whereas the brown clay will be tested 7 times.

The in situ groundwater-to-soil ratio is no greater then the porosity of the soil, which is the ratio of the volume of soil voids to the volume of soil. This ratio is typically between 20 and 40 percent. The ratio of soil to groundwater in the standard K_d method used at the FEMP is 8.75 (875 percent). The groundwater volume is large in practice because it produces a conservative result and it makes sampling of the solute possible during the test. In order to determine the impact of the groundwater-to-soil ratio on K_d levels, two separate calibration tests will be run. These calibration tests will consist of soil samples split from two grey clay soil samples. These calibration tests will include a groundwater-to-soil ratio of 0.50 (50 percent), only slightly larger than in situ conditions. These tests will be run without sampling, equilibrium will be determined by a duplicate test conducted in parallel. The test will be conducted exactly as the normal test, but samples will not be drawn. The container will be opened whenever samples are taken from the duplicate test. A final sample will be collected from the calibration tests when the duplicate test reaches equilibrium. The desorption test will be run for the two soil samples in the same way with a 0.5 clean groundwater-to-soil ratio. A final water and soil sample will be collected at the end of the desorption test. The results of this calibration test can then be compared to the duplicate test to see what impact the groundwater-to-soil ratio had on the K_d determinations.

The sorption isotherm describes the transfer of a product from liquid to soil under different concentrations in solution. The amount of product adsorbing from solution to soil will vary depending on the amount of product available in solution. The relationship is generally assumed to be linear, although many studies have indicated a non-linear relationship. The sorption isotherm can be determined by conducting a series of tests with different concentrations of product in solution. The results of the tests can be plotted on an initial versus final solute concentration graph. Each final solute concentration is plotted against its initial solute concentration, and all the tests are plotted on one graph. The resulting curve represents the sorption isotherm. Equations are available to determine the K_d under linear and non-linear sorption isotherm. Once the sorption isotherm is determined, more exact equations can be used to determine K_d. In order to determine the sorption isotherm, six tests will be run with different initial solute concentrations. The initial concentration will be varied by diluting contaminated groundwater with clean groundwater to achieve the desired initial concentration.

The tests will be conducted using the standard procedure and the results will be plotted to determine the sorption isotherm relationship. The six sorption isotherm tests will include four of the seven grey clay soil samples split from the grey soil samples. The groundwater concentration will be varied by combining uranium contaminated groundwater with clean groundwater.

The permeability of the soil can be maintained by keeping the samples as undisturbed as possible. Standard K_d practices require the soil samples to be dried, crushed, sifted, and agitated through the test. In an effort to determine the impact that these practices have on K_ds, two duplicate tests will be run in which the soil will not be disturbed or agitated but allowed to sit in contact with groundwater as in natural conditions. The two ~~duplicate~~ split samples will be split from two of the seven grey clay soil samples. The test will be performed identically to the standard method except for the agitation of the sample. The results of this ~~duplicate~~ split test can then be compared to the agitation method to bracket the conservatism inherent in the standard procedure.

The dissolved oxygen factor is complicated to duplicate because dissolved oxygen is limited at depth in the soil. In order to reproduce the in situ dissolved oxygen conditions, the K_d study would have to be performed in a closed reactor with as little dissolved oxygen as possible (possibly in a nitrogen gas environment). This condition is difficult to achieve because of the required sampling that takes place during the test. One solution to this is to run calibration tests alongside the normal K_d tests. The calibration tests will be set up in the same manner as the normal test, but the reactor will be sealed until the completion of the test. The two calibration samples will be split from two of the seven grey clay samples. Equilibrium will be determined using a duplicate test run in the normal manner. A sample will be collected at the end of the test when the duplicate samples achieves equilibrium. The results of the calibration test would then be compared to the normal test results to determine the affect of dissolved oxygen on the K_d study.

Table 8-9 ~~and 8-10~~ summarizes the K_d tests to be performed.

Note: The equation for the K_d is given in the DQO in Attachment I.

8.8.2.1 K_d Sample Preparation

TABLE 8-9

ASTM METHOD D-4319-83 TESTS TO BE PERFORMED FOR K_d DETERMINATION
7 brown clay adsorption/desorption tests - Standard methods, 100% contaminated water during adsorption test.
7 grey clay adsorption/desorption tests - Standard methods, 100% contaminated water during adsorption test.
4 grey clay (split sample) adsorption/desorption tests - Standard methods, one 75% contaminated water, one 50% contaminated water, one 25%, and one 0% contaminated water during adsorption test.
3 grey clay (split sample) adsorption tests - standard methods except that only 1750, 875, and 438 ml of 100% contaminated groundwater will be used.
2 grey clay (split sample) adsorption tests - standard methods except that no agitation of the sample will be performed. Disruption of the soil will be kept to a minimum.
2 grey clay (split sample) adsorption tests - standard methods except that only the reactors will be sealed and remain unopened until the end of the test. 100% contaminated groundwater will be used. No sampling will be conducted during study. Tests should be performed in parallel with standard grey adsorption tests that correspond with the split sample locations to determine equilibrium conditions.

For the 14 collected samples, the 400 grams (dry weight) of soil will be transferred to a 4.0 liter reactor without drying or crushing. Dry weight will be determined using a standard method on a portion of the soil sample. Pre-test agitation of the soil should be kept to a minimum. A 3500 ml sample of groundwater contaminated with a known amount of uranium will be added to the container at a pH consistent with perched groundwater pH levels (6.8 to 8.0). ~~The pH level will be adjusted with nitric acid or calcium hydroxide.~~

Two in situ groundwater-to-soil ratio tests will be performed in parallel with two duplicate normal tests. In these two reactors, only 200 ml of groundwater will be added.

Four diluted groundwater tests will be conducted in parallel with four normal duplicate tests. The diluted groundwater will consist of 3500 ml total solution, but 0.75, 0.5, 0.25, and 0 fractions of contaminated groundwater to clean groundwater.

When the first test is completed with contaminated groundwater, the reactor will be drained and the solids will be centrifuged. The solids will then be transferred to a clean reactor and 3500 ml of background groundwater will be added. ~~The pH will be adjusted as in the first test.~~ The two in situ groundwater-to-soil ratio tests will only have 200 ml of clean groundwater added to them.

8.8.2.2 K_d Sample Mixing

The samples will be placed in a rotating tumbler and mixed continuously until completion of the testing. The tumbler shall be operated at 29 +/- 2 rpm. Two reactors will be left untumbled throughout the test with a minimal soil disturbance.

8.8.2.3 K_d Collection of Samples During Testing

Samples of leachate will be collected after stopping the tumbler for a sufficient time period (minimum of 10 minutes) to allow the solids to settle. A volume of the leachate will be decanted from the reactor and filtered through a 0.45 micron filter paper. The volume of decant removed will be based upon the requirements for analytical testing (approx. 20 ml). After removal of the decant, 20 ml of pH adjusted water will be added back to the reactor. Any solids transferred during the separation step will be returned to the reactor.

Intermediate samples will be collected at approximately 72, 144, 168, 240, 288, 360, and 384 hours following initiation of the reaction and analyzed at the FEMP laboratory for total uranium. The reaction may be stopped earlier if the data indicate that equilibrium conditions between the soil and liquid have been achieved. Equilibrium will be determined by maintaining a plot of concentration versus time for each reaction.

Two reactors will remain untested during the program. The reactors will remain sealed. Equilibrium conditions will be determined by duplicate tests run in the standard method. Final samples will be collected from the two sealed reactors when the duplicate tests indicate equilibrium.

After the results indicate an equilibrium condition, a final solution sample will be collected and split for analysis by both the FEMP laboratory and an off-site laboratory. The final sample will be analyzed for total and isotopic uranium. Twenty-two solution samples will be collected at the end of the adsorption testing. If a sample does not reach equilibrium after 384 hours, a decision of whether to terminate the testing will be made.

Identical batch testing procedures will be followed for the second test. At completion of the second batch test, a water and soil sample will be collected from the tumbler and split for analysis by both the FEMP laboratory and an off-site laboratory. These final samples will be analyzed for total and isotopic uranium. Twenty-two solution samples and 22 soil samples will be collected at the end of the desorption testing.

8.8.3 Laboratory Performance Requirements

Analytical performance requirements shall be used as guidelines for evaluating laboratory capability to provide specific analytical services to the FEMP. Audits shall be performed to verify laboratory performance using the performance evaluation sample results specified in Appendix E of the SCQ.

8.9 SAMPLE ANALYSIS AND VALIDATION

Sample analysis and validation will be performed in accordance with the guidance and requirements contained in the FEMP SCQ. This task consists of sample management; chemical and radiological analysis; quality control; and data reduction, validation, and reporting. These subjects are discussed in detail in the SCQ. Geotechnical samples will not be validated and will comply with ASTMs.

Sample management and control will be in accordance with Section 7 (*Analytical Laboratory Sample Custody*) of the SCQ. Sample custody will be maintained and documented from the time of collection through analysis. Appropriate records will be maintained in the chain-of-custody process for sample tracking and control during shipment.

Analysis of samples and laboratory analytical procedures will generally be in accordance with Section 9 (*Analytical Procedures*) of the SCQ in conjunction with Appendix E of the SCQ. For all chemical analyses for which such methods exist, EPA-approved methods will be used as the FEMP method source. Where EPA methods do not exist, verified methods will be submitted to EPA for approval. Radiological sample preparation and analysis methods are specified in Appendix I of the SCQ.

Data reduction, validation, and reporting for each ASL will be in accordance with Section 2.3.3 (DQOs) of the SCQ. Numerical analysis, including manual calculations, mapping, and computer modeling, will be documented and subjected to ~~QC and~~ peer review. The Data Validation Plan is presented in Appendix D and the Data Management Plan presented in Appendix F of the SCQ.

Data validation is an independent and systematic assessment to determine if the sampling and analysis process met certain established criteria. The validity of a sample and the analytical information generated from the analysis of that sample are dependent upon various factors. The collection and examination of all significant information and data associated with the sampling and analysis process is essential for the validation process to be effective. This information and data is gathered from the scoping process through the final data archival or storage.

Once the samples are collected and sent to the appropriate laboratory for analysis, field information will be received by ~~SC/DM~~ Site Media Sampling to verify that all required field information is complete and accurate, and the information will be forwarded to Data Quality Management if the analyses generated for the task are either ASLs C, D, and/or E. Field records generated for ASL B analyses may also be forwarded to Data Quality. ~~validation, if the PSP has specified that this ASL data will require data validation.~~

No. 39 The laboratory will then analyze the samples per the requirements set forth in the ~~SAP~~ PSP. After the laboratory has analyzed the samples and verified that the quality of the data meets the requirements of the analytical method, and that all deliverables are included, the data will be delivered to personnel to perform the following tasks:

- Verify that all required deliverables have been received;
- Verify that contract performance requirements have been met. These contract performance requirements will be identified in the PSP;
- Enter data into the SED; and
- Copy data packages and deliver them to Data ~~Validation~~ Quality Management personnel. The original of the data packages will be stored in a secure location.
- Confirm with an initial screening that the appropriate information is present;
- Log the package into a tracking database;
- Assign a priority rating for the data package from the Manager of Data Validation; and
- Ensure that all QC information required to qualify data is present and create a field data validation summary report with supporting documents which can impact qualification of data from the laboratory.

The appropriate laboratory data validation subgroups are then notified by the ~~DVS~~ Data Quality Management (DQM) group that the data package is ready for their evaluation. The data is then validated by the appropriate validation discipline group (e.g. organic, inorganic/conventional, and radiochemistry) according to the appropriate validation protocols. The data will be qualified, data validation summaries will be generated, and checklists will be added to the data package. The validated data packages will then be reviewed/approved by ~~the Validation Group Coordinators~~ Analytical Laboratory Services (ALS) group and given back to the ~~DVS~~ DQM group. In addition, the data qualifiers will be entered into the SED. The ~~DVS~~ DQM group will assemble all reports and check lists into one data package, update the tracking data base, copy and file the validated data package, and send the ~~d~~Data ~~p~~Package back to the ~~DR&A~~ ALS.

Once ~~the~~ ~~DR&A~~ ADM receives the validated data package from ~~Data Validation~~ DQM, the validated data package will then be filed by ~~the~~ ~~DR&A~~ ADM into a secure file while copies of the data results, summaries of the data validation, the ~~DR&A~~ DQM cover letter and a listing of all other documentation available will be sent to Operable Unit 2.